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Erecting Shop Competition.

The erecting shop competition, announced in the April issue of the *Railway Mechanical Engineer,* closes on June 1 so that the time is limited in which those interested in this subject can submit articles to be considered for the two prizes. Please remember two things: The articles will not be judged primarily on their literary merits; contributions not awarded the prizes but containing ideas of merit will be published and paid for at the regular space rates. In view of the importance of erecting shop work and the comparatively little which has been written on this subject, it is hoped that a number of comprehensive articles will be received. There is no railroad erecting shop which has *all* the best practices and probably also no shop but has at least *one* good practice. Tell us about that one. The only way to raise the general standard of erecting shop work is by exchanging ideas and information regarding these *best* practices, which is the purpose of the erecting shop competition. Will you help us? The prizes, as announced, will be fifty dollars and thirty-five dollars for the two best articles on erecting shop practice, received at the New York office on or before June 1.

The Railroads' Equipment Program

According to an estimate recently made by the Car Service Division of the American Railway Association, car loadings for the year 1923 will exceed those of any previous year and will tax the capacity of the railroads to the limit, especially during the autumn months when the peak of traffic usually occurs. It is generally recognized that the supply of equipment has not been increased in proportion to the growth of the country and that the physical condition of locomotives and cars has not been kept up to the desired standard. To make up the deficiency in facilities, the railroads have spent two hundred and forty-five million dollars for locomotives and cars in 1922, and in 1923 they plan to spend six hundred and seventy-five million dollars additional. This equipment will help the situation but it cannot entirely make up the shortage. The American Railway Association has recognized this condition, and at its last meeting on April 5, the executives recommended a definite policy for taking care of the heavy traffic which is anticipated in the fall. The recommendations which directly affect the mechanical department are that by October 1 bad-orders cars, which at present are about nine per cent of all the equipment, should be reduced to five per cent, and that locomotives awaiting repairs should be brought down from twenty-two per cent to fifteen per cent.

An examination of the records for the past few months shows that the mechanical department will have a difficult task to perform in accomplishing these results. With the heavy traffic that is being handled at present, equipment is being worn out practically as fast as it is repaired. During 1921 and the first half of 1922, the shops repaired about twenty-two thousand locomotives per month. Since the first of this year, they have turned out an average of about thirty-eight thousand locomotives monthly, but this has resulted in only a slight reduction of the percentage of unserviceable locomotives. From July, 1922, to January, 1923, bad-order freight cars were reduced from fifteen per cent to nine per cent, but there has been only a very slight reduction during the first three months of this year.

It seems evident that the shops will have to be worked to the limit of their capacity to bring about the necessary improvement in equipment conditions during the summer months. Some roads are already reporting a serious shortage of mechanics, and other methods than mere additions to the number of shop employees will have to be used to increase production. It is encouraging to note that a few roads have adopted programs for extensive additions to their shop facilities and if others would profit by their example, the difficulties experienced at present in maintaining locomotives and cars could soon be overcome.

In spite of the emphasis that has been placed on the necessity for adequate shops for taking care of modern rolling stock some roads apparently are still buying equipment without providing a corresponding increase in repair facilities. Such a policy will give temporary relief, but in the last analysis the railroads must turn out of their shops repaired cars and locomotives capable of making as many car-miles and locomotive-miles as are required to handle the business, or their equipment condition will deteriorate. In the interest of economical operation, the capacity of the shops should be brought up to the point where they will be able to do the necessary amount of repair work under normal conditions without resorting to periodical campaigns to bring down the percentage of bad-order equipment.

Car Department and Transportation Expenses

At the present time freight cars are in such great demand that most shops find it difficult to supply all the equipment needed by shippers. There is a strong temptation under such conditions to make less rigid inspection and to approve for loading cars that have minor defects. Sometimes it may be permissible to make a liberal interpretation of inspection rules, but car men should realize the extent to which they are responsible for transportation expenses and how much errors of judgment may cost the railroad. For example, during the year 1921 derailments and other accidents due to defects and failures of equipment cost the railroads over ten million dollars. Probably a large proportion of this could not have been avoided by the most careful inspection, but at the same time it emphasizes the losses that may occur if defects are passed by. Loss and damage to freight due to defective equipment is another large item of expense, the total loss in 1921 being likewise about ten million dollars. The defect which caused the greatest loss was leaks in roofs. Defective grain doors, water leaking in around doors, defective lining or siding and protruding nails and bolts were the other principal sources of loss.

Transferring loads is another item of transportation ex-

pense which the car department can help to minimize. Considerable reductions can sometimes be effected by repairing cars under load wherever possible, but in this case prevention of the cause of transferring is the most effective measure. Proper preparation of cars for the commodities they are to carry requires considerable care, but the savings to the railroad by eliminating labor charges for transferring and by expediting shipments make it well worth while to give this matter special attention.

Labor-Saving Machinery in Pattern Shops

The railroad pattern shop is often more or less neglected as regards machine equipment in spite of the fact that this department, in proportion to its size, affords as great an opportunity for economy by the use of labor-saving machinery as any other shop department. It frequently takes weeks to make some of the larger, more complicated patterns, whereas the time and cost of this work can be reduced often as much as fifty per cent if the pattern shop is equipped with such machines as the variety saw bench, power sanding machines, portable hand planers and jointers, and in particular the universal wood milling machine. The latter type of machine performs the same function for the pattern shop as the universal milling machine for the machine shop, being used for making wood, brass and soft metal patterns. It is well adapted for core box work, grooving, trenching, jointing, routing, surfacing, cutting segments of circles, etc. Core holes can be cut to a uniform depth and equally divided by the use of this machine in a fraction of the time formerly required. The universal dividing head provides means for quickly milling gear teeth exactly alike, uniformly spaced and with the proper allowance for draft.

In one case where thirty thousand dollars' worth of patterns had been destroyed in a fire, these patterns were restored in a short time during which a new wood milling machine more than paid for itself. One of these sets of locomotive patterns, which previously cost nearly thirteen hundred dollars to build, was made with the universal wood milling machine at a cost of slightly over six hundred dollars. One foreman pattern maker testifies that he can make a set of core boxes for a pair of locomotive steam pipes in fifteen hours, which, without the wood-milling machine, would require fifty to sixty hours. By having the foreman or assistant pattern shop foreman go over the drawings on every job and pick out the work that can be done on this machine, enough work will be found to keep it busy and pay a handsome return on this investment, even in relatively small shops where the importance of cutting down hand operations to the minimum is not always appreciated.

Fuel Oil-Burner Efficiency

It is a serious question if all, or even a majority, of railroad shop managements fully realize the relation of fuel oil-burner efficiency to successful furnace operation and the economical use of fuel. Exact figures as to the number of fuel oil furnaces of various types used in railroad shops in the United States are not available, but if they were, and the annual consumption of fuel oil for these furnaces could be determined, the importance of efficient burners would be apparent. Fuel losses of twenty-five per cent are readily possible in cases where burners of the wrong type are improperly installed or operated. Are your burners one hundred per cent efficient?

Under varying furnace conditions and requirements, oil burners must thoroughly atomize the fuel oil, mixing it with the right proportion of air. A burner suitable for use on one type of furnace may not be adaptable to another type. For forging, heating and welding furnaces, for example, a burner is required which will give the soft soaking heat needed for forging, or the reducing heat needed for welding; all air used for atomizing and for combustion must be under the absolute control of the operator. For heat treating, tempering, annealing, etc., the burner must be capable of adjustment to give finely-regulated, uniform temperatures, the burner highly atomizing the fuel and giving a short flame. For regenerative mechanical draft or stack draft furnaces another type of burner is required, and for high temperature work, still another. Burners not scientifically designed to meet the individual operating requirements will be wasteful of fuel. Burners of the proper type but not properly applied or intelligently operated will also cause excessive fuel costs.

The problem of selection, application and operation of the right oil burners for furnaces requires a more thorough knowledge of combustion principles than has been acquired by the average railroad shop man and it is important that expert advice be obtained on these matters, not only in the case of new installations of oil-burning furnaces, but where these furnaces are already in operation. Most of the reliable manufacturers of oil-burning equipment are willing to give the benefit of their experience and advice as furnace engineers without cost, and it is greatly in the interest of the railroads to use this engineering service in making sure that they are now getting the best possible results with oil-burning furnaces and equipment.

Centenary of the Delaware & Hudson

ON April 23 the Delaware & Hudson Company celebrated the one hundredth anniversary of its incorporation with suitable ceremonies at New York and Scranton. It is an interesting circumstance that when this company was formed, it was principally for carrying on coal mining and transportation by canal. At that time railroads were hardly considered practical and the locomotive had yet to prove its superiority over the horse. The gravity railroad from Carbondale to Honesdale was constructed in 1827 to supplement the D. & H. canal and the first locomotive was tried out in 1829. It was found to be too heavy for the rails and was set aside and not used.

The centenary was the occasion for a review of transportation developments in this country which brought out in a striking manner the important part which railroads have played in the development of the nation. Looking back on such a significant occasion to consider the conditions existing one hundred years ago should make critics of our present system realize what progress in industry and transportation has done to promote the well-being of the people.

Even as recently as one hundred seventy-five years ago there was hardly need for an extensive transportation system. Food, clothing and fuel were produced locally and for the most part by primitive methods that had changed little in a thousand years. Farming was the principal occupation and was carried on by arduous manual labor. Clothing was produced on a small scale. To spin thread and weave cloth women and girls spent every spare moment at the distaff, or working hand looms. Wood cut locally was practically the universal fuel.

About 1750 there was brought out in England the first of a series of inventions which are largely responsible for our modern industrial system. John Kay and his son, Robert, applied two inventions to the loom which doubled its capacity. Soon after Robert Hargreaves invented the spinning jenny, the first machine for making thread. From that time on progress was rapid. Arkwright, Paul and Crompton added improvements to textile machinery. About 1790 Edmund Cartwright developed the power loom, and Eli Whitney the cotton gin.

In the meantime, the search for power more adaptable and reliable than water or wind had been going on. Newcomen invented the steam engine about 1700 and in 1769 James

Watt brought out the first of a series of improvements which made it of almost universal application and greatly increased its power and efficiency. Closely allied with the problem of power was that of fuel. Prior to 1750 the production of iron was dependent upon the supply of wood, but when the use of coal was begun in England, the output increased greatly. The steam-driven pump and the safety lamp made available a large supply of fuel which could be mined safely and cheaply.

These inventions together enabled production to be carried out on a larger scale and far more efficiently than before, but without improved transportation there would have been little benefit from the ingenuity of the great inventors. Quantity production would have been useless without facilities for widespread and economical distribution of raw material and finished goods, for which horse-drawn vehicles were entirely inadequate. Adam Smith wrote, "A broad wheeled wagon attended by two men and drawn by eight horses in about six weeks' time brings back between London and Edinburgh (400 miles) a four-ton weight of goods."

Contrast these conditions, which existed a brief one hundred years ago, with our modern transportation system. Two men can now handle machines that exert three thousand five hundred horsepower. Thirty pounds of coal, a lump about ten inches square, will haul one thousand tons a mile on level track. We are likely to accept as commonplace the fact that the cost of transportation is so low that fresh fruits from California can be sold in Maine at a reasonable price. As a matter of fact, it is a wonderful achievement and illustrates how much the railroad has done to give to the common people of today advantages which kings could not command a hundred years ago. In the realization of what transportation means in modern life, every railroad man should find an inspiration to further progress.

New Books

HANDBOOK OF STEAM LOCOMOTIVE CONSTRUCTION (*Handbuch des Dampflokomotivbaues*). *By Dr. Martin Igel. 606 pages, 5½ in. by 8 in., 10 plates, bound in cardboard. Published by G. Reder, Berlin, Germany.*

European locomotives show a greater diversity of general design than is usual in America and this probably explains why many more treatises on motive power are published in foreign countries. The majority of these are of considerable interest to American readers because they illustrate numerous unusual designs. In this book the author has attempted to cover an extremely wide field in a short treatise.

The first chapter deals very briefly with the history of locomotive construction, which is followed by statistics of operation and a list of builders in various countries. In developing the general theory of locomotive design, various elements of resistance are first taken up and the method of calculating the leading dimensions of the locomotives are outlined. The section dealing with the details of construction is comprehensive and in general is well illustrated. Some interesting diagrams for adapting wheel arrangements to curves are shown. The section on counterbalancing, while brief, gives a good idea of the methods used with various types of locomotives. The description of cylinder and wheel arrangements is unusually complete. Boiler and machinery parts are shown which are typical of standard practice, and also some of the most radical innovations. Following the portion on the details of design is a section which includes photographs, drawings and condensed descriptions of a wide variety of representative locomotives from all over the world.

The book is elementary in some respects, principally because of the attempt to cover an extremely wide field in a small space. It should be useful to anyone who wishes to get a bird's-eye view of locomotive development in general and, in particular, the practice of the German railways.

What Our Readers Think

Co-ordination Needed to Get Results

CHICAGO.

TO THE EDITOR:

The abstract of the paper by G. M. Basford, published in the April issue of the *Railway Mechanical Engineer*, has no doubt been read with interest by many of your readers, and while perhaps complete agreement as to methods of attaining the results indicated could hardly be expected, no one except those "who have eyes to see and see not" will deny that we are commencing an era of refinement of locomotive design by real engineering methods, instead of rule of thumb, and that such refinement is becoming imperative owing to limits having been almost reached.

In the writer's opinion, the paragraph commencing, "Many operating officers do not yet realize—" and ending, "We must tell them about it," strikes the keynote of the whole situation; for what is the use of the refined locomotive if all departments of a railroad that will use directly or indirectly such modern power are not equally refined and efficient in their methods? Co-ordination of design in locomotive detail and facilities is good, but co-ordination of effort of department with department, officer with officer, and officer with rank and file of the railroads themselves is in the writer's opinion of first necessity.

One has only to trace an order for equipment, for instance, back to its genesis to make the lack of co-ordination apparent. For example, a railroad has a "hunch" that more and better equipment is wanted. After months of voluminous interdepartmental and committee correspondence, all of which could often be boiled down into one comprehensive letter by any business man outside a railroad who really knew what he wanted, the mechanical department is asked to prepare specifications, drawings of standards, etc., the time allowed being about one week, and most generally varying inversely as the value of the order.

The specification being merely a re-hash and hodge-podge of previous specifications means about as much as the prior correspondence, so that in order to protect himself from any lurking danger of subsequent litigation, the builder will draw up a concise and business-like specification and return it to the railroad for approval and check, with a polite letter hiding the real reason.

Or again, a mechanical department proceeds to make all arrangements to build some cars only to find from an outside source that an order has already been placed weeks before by some other department, with an outside concern.

How will the refined locomotive fare at the hands of officials who have not the technical training to appreciate it, or under a condition where any petty officer or even locomotive man may have its lap, lead, or exhaust nozzle, etc., changed to suit his particular whim or fancy without a thorough investigation by the engineering staff of the mechanical department first?

Again, not a few railroad officers seem to be incapable of placing proper values on any new device brought before them and are not always willing to accept the advice of those most capable of giving a disinterested opinion. Hence we find they are very much impressed by so-called tests and comparisons, always, of course, in favor of the device. Such tests are generally found to have been carried out under quite different conditions, and so are valueless from an engineering point of view although no doubt useful as "selling talk."

Absence of co-ordination spells avoidance of individual responsibility and leads to "passing the buck." How can co-ordination of effort be obtained when a head of a depart-

ment does not know the men working for him even when they are on the same floor of the office building? To use an analogy, how can a locomotive deliver ton-miles if the engineer is not sufficiently interested to see for himself whether each part of his engine functions properly, nor keen enough on his job to see whether more work per pound of coal can be obtained by careful instruction of his firemen, attention to small details, etc.?

If departmental heads did make it part of their business to really know their men, we should not have incompetents getting relatively high salaries and technical men with ability being driven out of railroad service to more lucrative and appreciative, although not by any means more interesting, fields of endeavor.

When conditions in railroad operating and mechanical departments are such that only thoroughly trained technical men have the deciding voice, then the highly refined locomotive will have an open road, with resulting lowered costs to the public, higher dividends to the shareholders and higher salaries to railroad employees all around.

It is very doubtful if the builders always have the freedom to turn out as good a locomotive as they are capable of doing, owing to prejudice, badly written specifications and desire on the part of the railroad to incorporate perhaps some device that does not harmonize with the whole or refusal to accept another that might mean the difference between efficiency and inefficiency in the particular engine. ENTROPY.

Effect of Length of Center Sill on Impact Stress

BUTLER, PA.

TO THE EDITOR:

In his article, "Present Day Tendencies in Car Construction," in the *Railway Mechanical Engineer* for March, 1923, E. R. Viberg states that with the final buffing shock taken by the striking plate, the center sill is increased considerably in length and naturally makes a weaker structure than would be the case if the shock is delivered to the rear draft lugs. The writer believes this statement to be incorrect and that instead of creating a weaker structure, this increased length will reduce the effect of buffing shock upon the center sill, car structure and lading.

Whether the solid impact be delivered to the center sill at the lugs or at the striking plate, the unsupported length of the sill does not alter. If the center sill is assumed to be a column resisting a static load applied at the lugs, the unsupported length of the column may be assumed as the distance between bolster centers; although the cross bearers will contribute toward staying the column both laterally and vertically, especially if the car sides are the load-carrying members. If the load be applied at the striking plates, the above assumptions will still hold good: The column is stayed at the same points by center braces, bolsters and cross bearers. In discussing these assumptions, however, it should be remembered that the impact shock is a dynamic and not a static load, and that a resilient structure will have less stress under a dynamic load than a rigid one.

The following practical illustration shows that a long center sill will absorb more energy and so help the draft gear to dissipate the impact, than will a short one. If one should attempt to cut off a rivet head with a 2-ft. cold chisel and a 2-lb. hammer, the hammer blow will be absorbed by the long chisel and very little cutting effect produced. A shorter chisel will cut faster with the same expended energy because less energy is absorbed by the short chisel and so the force delivered at the rivet head is greater. The analogy is true for the center sill.

That a given impact will produce less stress in a long sill than in a short one, lends itself to simple mathematical proof. If the impact energy is denoted by B, the force produced in the sill by P and the amount of compression by D, we may write $B = \frac{P \times D}{2}$ since the force increases from zero to P and we are assuming the stress to be within the elastic limit of the material. If f is the unit stress and A the area of the sill than $P = f \times A$. Since $E = f \div \frac{D}{L}$ where E is the modulus of elasticity and L the length of the column, then $D = \frac{f \times L}{E}$ which shows, incidentally, that the amount of compression varies directly as the unit stress and the length. Substituting the new values for P and D in the first equation, we obtain $B = \frac{A \times L \times f^2}{2 \times E}$ showing that the capacity for absorbing energy is directly proportional to the area, the length and the square of the unit stress. Transposing, we have $\frac{2 \times E \times B}{A} = L \times f^2$ which may be written, $K = L \times f^2$, because for a given impact, area and material, B, A and E are constant. Now let c be the stress for a length C and f the stress for a length L. Then $K = C \times c^2 = L \times f^2$ and $f^2 = \frac{C \times c^2}{L}$, or $f = c\sqrt{\frac{C}{L}}$ which shows that the stress varies inversely as the square root of the length.

Assume the length over striking plates as 41 ft. 4½ in., or 496.5 in., the length over draft lugs for 3-in. draft gear travel will then be 410.75 in. If a given impact applied at the lugs produces a stress of 20,000 lb. per sq. in. in the sill, the same impact applied to the striking plate would produce a stress of $f = 20{,}000\sqrt{\frac{410.75}{496.50}} = 20{,}000\sqrt{.829}$ $= 20{,}000 \times .910 = 18{,}200$. This is a reduction of 1,800 lb. per sq. in., and for a shorter car the decrease is even greater. Thus for a car whose length over striking plates is 33 ft. 6 in., or 402 in., the length over rear lugs is 316.25 in. Using the same comparison, we find the stress to be $f = 20{,}000\sqrt{\frac{316.25}{402.00}} = 20{,}000\sqrt{.787} = 20{,}000 \times .887$ $= 17{,}740$, a reduction of 2,260 lb. per sq. in.

It is therefore evident that applying the final impact shock to the striking plate, instead of attempting to apply it to the rear lugs, results in a stronger structure. This statement, of course, presupposes the coupler horn to be made concentric with the center line of the coupler as suggested by the writer in his article, "Protecting the Draft Gear from Solid Impact." (Published in the *Railway Mechanical Engineer*, November, 1922).

Furthermore, the added length not only relieves the center sill from a large amount of stress, but it is obvious that the increased resilience will aid the body bolster considerably. Using the analogy of the long and short chisel, given above, it is evident that the short length between lugs and bolster will deliver a larger impact force to the bolster than would the length from striking plate to bolster and so the entire car structure and the lading would be benefited by the increased resilience. WENDEL J. MEYER.

Fuel Consumption of Oil Burning Locomotives*

Data Obtained on Southern Pacific Facilitate Comparison of Steam and Electric Motive Power

By A. H. Babcock
Electrical Engineer, Southern Pacific Railroad

PART I

WHENEVER electrification of steam railways on a large scale is advocated, one of the principal arguments advanced is the large saving in fuel sure to result therefrom; in fact, this was the initial point of attack in the early days of the art—the early 1890's, for example—long before overtime of train and engine crews had become the very real expense in train operation it is today. Many attempts to get accurate information on locomotive fuel consumption have been made during the intervening years, for comparison with known electric locomotive performance.

Fuel consumptions of steam locomotives using coal cannot be analyzed as can those of electric locomotives, because

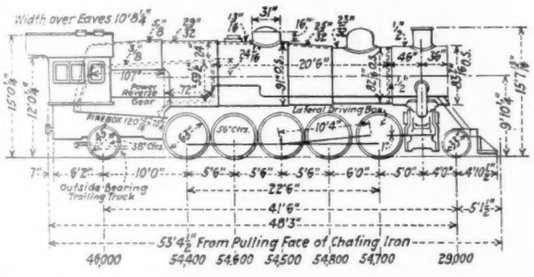


Fig. 1—Side Elevation of Locomotive No. 3614

it is impossible to obtain accurate measurements. When fuel oil is used, the possible accuracy of such measurements more nearly approaches that of electric operation, and much more precise determinations are possible.

By the use of accurately calibrated oil meters; by locating with reference to track conditions, points at which meter readings shall be taken; by choosing an engine that has shown an average fuel performance under widely different operating conditions; by giving this engine loads as closely as possible to its rating; and by not changing the train consist over the run, an accurate measure of fuel consumption for any given piece of track—over a mountain, for example—can be had.

In connection with and bearing directly upon electrification possibilities, such a study has been made of the track over the Tehachapi Pass, where topographical and operating conditions are severe; also they are representative of mountain railways on the west coast.[1]

Engine No. 3614 was selected because the records of the fuel bureau showed it to be an "average performer" in through freight service. Its characteristics are given in detail, Tables 1 and 2. On every run a different engine crew handled the train, the selection being by the usual "first in, first out" method standard on the railway. A trained observer rode the engine and made all the readings. The train weights, taken from the yardmaster's reports at the initial points, were corrected, during the runs, for fuel and water consumed.

George McCormick, general superintendent motive power, Southern Pacific Lines, afforded every facility of his department in the prosecution of the work; he prepared the engine and made valuable suggestions.

The division officials inconvenienced themselves many times to permit a single engine train to run without change of load over a congested piece of track.

William Hood, for many years chief engineer, Southern Pacific, who located and constructed this line, named the points at which the track conditions change in significant fashion. It was found during the test runs that all engineers handled the trains very much alike, changing throttle or cutoff at or near the flags that had been placed at the points selected by Mr. Hood; from which it was evident that the points so chosen were really representative. The positions of all these reference points are given in Fig. 3. Meter readings and times were recorded at all grade changes, (marked by these flags, or by the natural marks at such points), and at all starts and stops. The fuel oil was metered through a new two-inch duplex piston type meter that had been calibrated by weight measurements corrected for temperature. In the final analysis all fuel measurements were reduced to 60 deg. fahr. Approximate water measurements were made, not to determine evaporation, but as correction factors on the train tonnage. Similar fuel corrections were made.

The train tonnage, then, is gross weight of train from engine pilot to caboose markers, everything included.

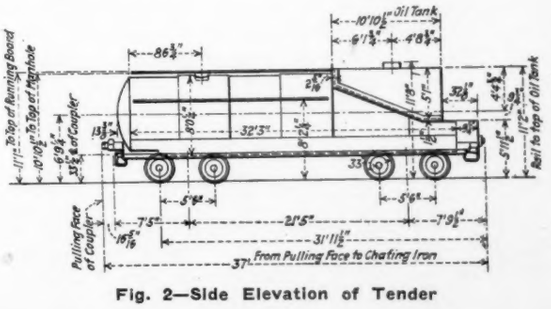

Oil Tank
To Top of Running Board
To Top of Manhole
To Center of Coupler
Rail to Top of Oil Tank
Pulling Face of Coupler
From Pulling Face to Chafing Iron

Fig. 2—Side Elevation of Tender

The result is a complete record of fuel consumption beginning with the enginehouse firing up and standby fuel consumption until the engine was called; while standing outside the house waiting for the train, testing brakes, during acceleration, running up and down the various grades, holding the train in sidings, and finally running down hill over long stretches of steep grade.

In the ordinary system of fuel records all fuel consumed in firing up, standing in the enginehouse and on the outgoing track up to the time the engineer assumes responsibility *i e.*, thirty minutes before he is called to leave the terminal,

*A paper presented at the spring convention of the American Institute of Electrical Engineers at Pittsburgh, Pa., on April 25. This is the first part of an article in two parts. It describes a method employed for securing an accurate measurement of the efficiency of an oil-burning steam locomotive in moving a 1,000-ton train over a given piece of track. The second part of the article will describe the manner in which the method was applied and will include the results obtained.

[1]See also TRANSACTIONS, American Institute of Electrical Engineers, Vol. XXXII, p. 1845, "Mountain Railway Electrification."—*Babcock.*

is charged to enginehouse service; all consumed from that time until the engine is placed on the incoming track at the end of the run is charged to road service.

Such records, brought probably to the highest state of perfection in the practise of the Southern Pacific Company, give merely a method of distribution of charges between departments, provided a basis of comparison between present and past performances quite sufficient for economic operation in pre-war days, but by no means adequate in these days of intensive economic studies. No details of performance are uncovered.

TABLE I

Specifications for 2-10-2 Type Locomotive No. 3,614

Cylinders, diameter and stroke	27½ in. by 32 in.
Weights in working order:	
On drivers	273,000 lb.
On front truck	29,000 lb.
On trailing truck	46,000 lb.
Total engine	348,000 lb.
Wheel bases:	
Driving	22 ft. 6 in.
Total engine	41 ft. 6 in.
Driving wheel, diameter outside tire	63 in.
Boiler:	
Steam pressure	200 lb.
Diameter, first ring, outside	82 7/8 in.
Firebox, length and width	120⅛ in. by 75¾ in.
Combustion chamber length	72 in.
Tubes, number and diameter	279—2 in.
Flues, number and diameter	40—5⅛ in.
Length over tube sheets	20 ft. 6 in.
Grate area	63 sq. ft.
Heating surfaces:	
Firebox and comb. chamber	327 sq. ft.
Tubes and flues	4,130 sq. ft.
Total evaporative	4,457 sq. ft.
Superheating	972 sq. ft.
Comb. evaporative and superheating	5,429 sq. ft.
General data estimated:	
Rated tractive force, 85 per cent	65,300 lb.
Cylinder horsepower (Cole)	2,724
Weight proportions:	
Weight on drivers ÷ total weight engine, per cent	78.5
Weight on drivers ÷ tractive force	4.18
Total weight engine ÷ cylinder hp.	127.6
Boiler proportions:	
Comb. heat. surface ÷ cylinder hp.	1.99
Tractive force ÷ comb. heat. surface	12.02
Tractive force × dia. drivers ÷ comb. heat. surface	758
Cylinder hp. ÷ grate area	43.1
Firebox heat. surface ÷ grate area	5.2
Firebox heat. surface, per cent of evap. heat. surface	7.3
Superheat. surface, per cent of evap. heat. surface	21.8

These may be divided into three groups:

1. Variation of fuel used in firing up with respect to feed water temperatures, *i. e.*, losses independent of the manner in which the engine is used after steam is raised.

2. Fuel burned in holding the engine under steam at terminals or on the road; *i. e.*, losses dependent upon operating staff efficiency rather than upon tonnage, and independent of speed.

3. Fuel consumption while moving; accelerating, running, entering and leaving sidings, etc., all of which are dependent largely upon tonnage, and speed. With known tonnage, as in these tests, the ton-mile fuel cost becomes known over widely varying road and running conditions.

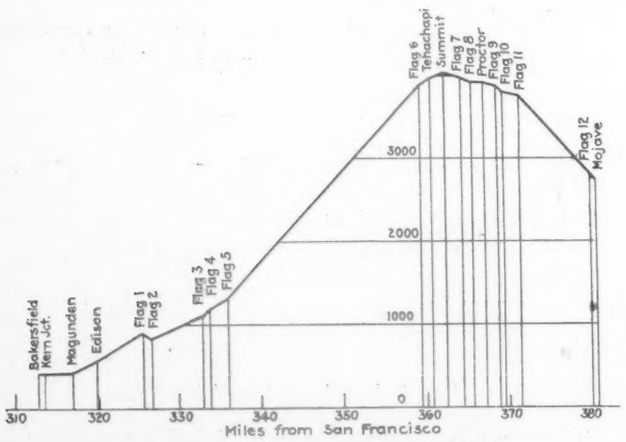


Fig. 3—Profile Map, Bakersfield to Mojave

Group 1. For this determination the boiler was filled to ⅓ gage glass (engine in enginehouse), with water at 120 deg. fahr. Steam for oil atomizer and blower was taken from the house steam lines until the boiler pressure reached 70 lb. gage. Fig. 4 shows fuel with respect to boiler water temperature and steam gage pressure. A second curve shows fuel consumption with time. Evidently not all the heat in the fuel reached the water at first because of the cold firebox lining.

From other tests it has been determined that the atomizer and blower add 14 per cent to the fuel consumption. Therefore, if 14 per cent of the 84 gal. used up to the time when the boiler furnished its own steam for these purposes be added to the 119 gal. metered to the burner to bring the boiler pressure up to 200 lb. gage, we have 131 gal., total fuel used to raise steam with feed water at 120 deg. fahr.

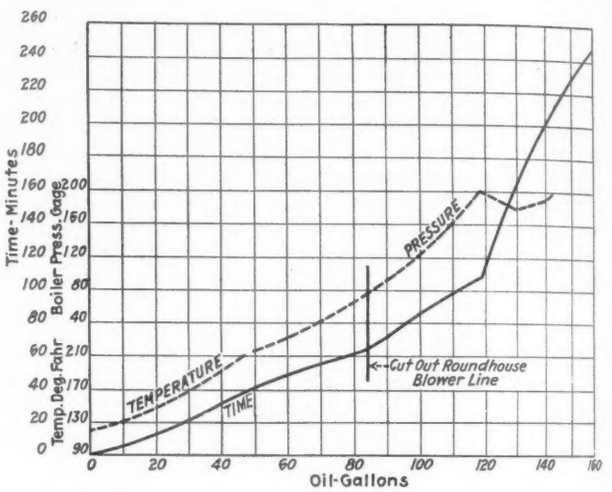


Fig. 4—Fuel and Time Required for Firing Locomotive

If it be assumed, as seems reasonable all things considered, that the fuel consumption for all practical purposes is proportional to the rise in temperature, the fuel per degree rise is 47/(210-120), or 0.522 gal.; from which then can be determined value of storing the heat from boilers being blown down for washing, to use in firing up other engines for the road. Thus, to fire up with feed water at 60 deg., ordinary hydrant water, costs 1.14 [0.522 (212 — 60) + (84 — 47)] + (119 — 84) = 167 gal. Similarly for 180 deg. feed water, from a hot water boiler washing and filling plant; 1.14 [0.522 (212 — 180) + (84 — 47)] + (119 — 84) = 96 gal.

TABLE II

Specifications for 10,000-Gallon Cylindrical Tender

Capacity of fuel oil	3,120 gal.
Capacity of water	10,030 gal.
Weight of tender empty	64,900 lb.
Weight of 10,030 gallons of water	83,600 lb.
Weight of 3,120 gallons of fuel oil	24,960 lb.
Weight of tender loaded	173,460 lb.
Tender axle journals	6 in. x 11 in.
Weight of truck	8,580 lb.
Height from top of rail to bottom of tank (loaded tender)	2 ft. 9¼ in.
Width over front steps	9 ft. 6 in.
Width over back steps	10 ft. 2½ in.
Extreme width over end sills	9 ft. 10 in.
Diameter of tank outside	8 ft. ¼ in.

With fuel oil at $1.50 per bbl. the 71 gal. saved per engine fired up amounts to $2.54, but the money saved by such procedure is even more than is apparent from the figures, because the time of turning an engine washed and filled with hot water is, by record, 3½ hours less than the 7½ to 8 hours required when cold water is used. Heavy power represents an investment worth at least $4.00 per hour. It

could not be rented for this figure. Hence the time saved adds $14.00 per engine turned to the fuel saved, and the total economy then is $16.54 per engine turned.

Group 2. The upward branch of the time-oil curve, Fig. 4, shows the fuel required to hold an engine under steam while standing in the enginehouse where these tests were made, to be 60(159 — 119)/(246 — 108) = 17.4 gal. per hour. It is fairly representative of large engines standing in a well kept enginehouse, no auxiliaries running.

Power of this class has air reverse gear; hence, if the engine is standing where occasional movements must be made, at least one air pump must be cut in. During the tests it was determined by placing this engine in the open yard, that oil was used at the average rate of 36.6 gal. per

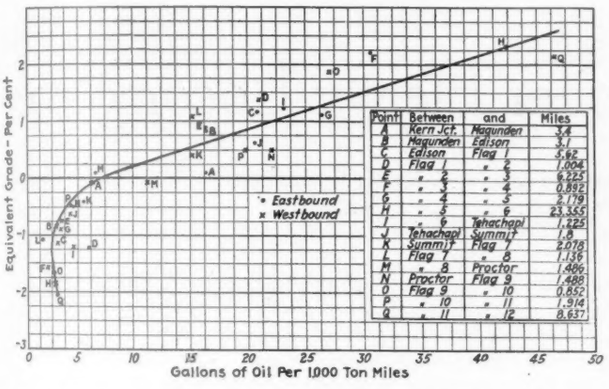

Equivalent Grade - Per Cent
Gallons of Oil Per 1,000 Ton Miles
• Eastbound
× Westbound
Point | Between | and | Miles
A | Kern Jct. | Magunden | 3.4
B | Magunden | Edison | 3.1
C | Edison | Flag 1 | 5.62
D | Flag 1 | " 2 | 1.004
E | " 2 | " 3 | 9.225
F | " 3 | " 4 | 0.892
G | " 4 | " 5 | 2.179
H | " 5 | " 6 | 23.345
I | " 6 | Tehachapi | 1.225
J | Tehachapi | Summit | 1.8
K | Summit | Flag 7 | 2.018
L | Flag 7 | " 8 | 1.136
M | " 8 | Proctor | 1.406
N | Proctor | Flag 9 | 1.488
O | Flag 9 | " 10 | 0.852
P | " 10 | " 11 | 1.914
Q | " 11 | " 12 | 0.637

Fig. 5—Fuel Consumed per 1,000 Ton Miles on Various Grades

hour. Air temperatures during this period ranged, roughly, from 20 deg. to 50 deg. fahr., therefore 36.6 — 17.4 = 19.2 gal. is the excess fuel consumed per engine-hour when standing in the open in ordinary weather.

Similarly, the fuel cost of standing on sidings with full tonnage train, is found to be 42.8 gal. per hour. Since no steam was used for heating in either case, 42.8 — 36.6 = 6.2 gal. is the fuel cost per hour of maintaining air pressure in the train line, ready for service.

Group 3. The results obtained for the first two groups are evident upon even a cursory study of the curves; but to obtain results for the third group a more rigid treatment is necessary. The reduction of the test observations in these determinations occupied many weeks full time of the two observers (who rode the engine alternately during the tests), C. M. Barbour and R. S. Twogood, assistant engineers, Southern Pacific Company. Mr. Twogood is responsible for the details of the test and the analysis of the results. To him acknowledgments are due for the following, most of which are taken literally or abstracted from his report.

In the reductions of the observations, the fuel oil density is taken at 0.96; the heat content 18,000 B. t. u. per pound. The constants to correct the meter readings for meter error and to reduce to standard temperature, 60 deg. fahr., are:

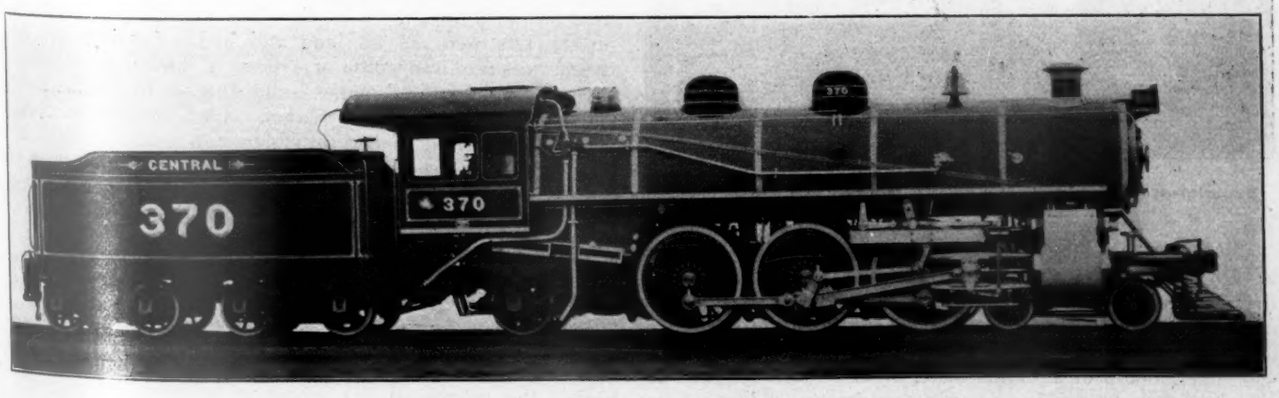
Oil Temperature	Meter Constant
130 deg.	0.949
120	0.952
110	0.956
100	0.959
90	0.965

The time, fuel meter reading, fuel temperature, and location of train, were recorded at every start, grade change or other important point, and stop. The speeds were determined by counting engine driver revolutions. All grade changes at other than station points were marked by white flags—see profile, Fig. 3. Grade compensation for curvature is applied at 0.04 per cent grade per degree of curvature. The equivalent grades eastbound and westbound for the same section of track obviously are of opposite sign, and of different numerical value.

From the log sheets of the trip were tabulated: fuel metered, fuel consumed, fuel and water in tender; time running at normal speed, running slowly and standing. These sheets then were reduced to show for every section of the track: the train weight corrected for fuel and water consumed, the times between sidings, running through sidings, running between stations or flag points, and standing. Then by combination of these elements there were deduced: Total train resistances, horsepower hours at drivers, thermal horsepower-hours based on actual average thermal efficiency for the trip, and computed fuel vs. actual fuel burned. Based on Schmidt's tables, the train resistance for level tangent track was taken at 7 lb. per ton. The average thermal efficiency was determined from the total horsepower-hours and the fuel burned when moving over sections where the total resistance was positive. A fair average standard time and fuel used to fire up, stand by, test air, and put engine away, were assumed for all trips.

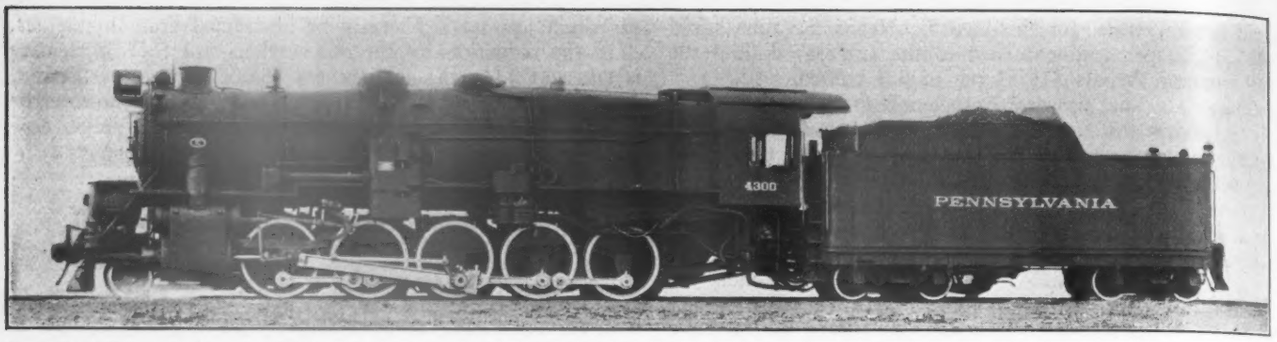
The average gallons of fuel per thousand ton-miles, in both directions, for every section of tracks, but not corrected for variations in speed within a section, were determined under actual operating conditions of the test, and are shown in Fig. 5 plotted against equivalent grade; wherein the curve as drawn has been adjusted to give fuel requirements for constant speed. Thus is shown the fuel cost of acceleration, and how, in the stop, provided the brakes are not used, a large proportion of the work done in acceleration is made useful in moving the train over the track. This is indicated by points on the left of the curve; points on the right show increase fuel consumptions during acceleration.

(To be continued)



Broad Gage Pacific Type Locomotive for the Central Railway of Brazil

Built by the American Locomotive Company and Displayed at Brazilian Continental Exposition.

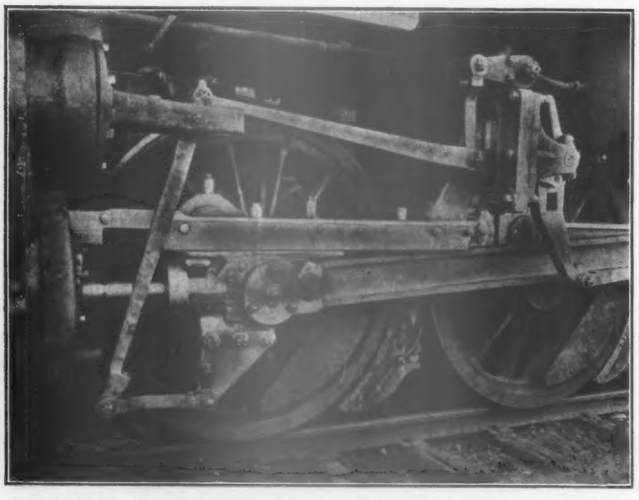


Pennsylvania 2-10-0 Type Locomotive, Class 11s, of which 475 Have Been Ordered Recently

Unique Type of Crosshead for Heavy Locomotives

After Extended Experiments Pennsylvania Adopts Crosshead with Large Bearings Which Greatly Increase Durability

THE Pennsylvania Railroad Decapod locomotives, Class I1s, are noteworthy in the size of the cylinders, the high steam pressure employed and the limitation of the cut-off in full gear to 50 per cent. With cylinders 30½ in. in diameter by 32 in. stroke and a boiler pressure of 250 lb. per sq. in., the maximum piston thrust reaches the unusual figure of 182,655 lb. As the main rods are 11 ft. 1½ in. long, the maximum vertical thrust on the crosshead, with no vertical offset between the center lines of the cylinders and the wheels, would be about 22,000 lb. The design of a suitable crosshead was made even more difficult by the limitation in permissible width of guides caused by the restrictions of 91½-in. cylinder centers and a distance

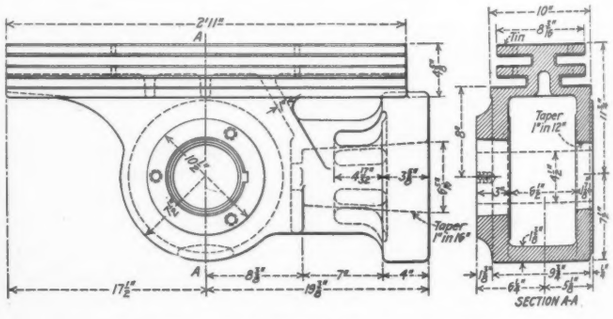


Experimental Crosshead Applied to Pennsylvania 2-8-2 Type Locomotive, Class L1s

of 70 in. over the outside hub faces of the main pair of driving wheels. The reduction of the unit bearing pressure on the crosshead therefore presented a difficult problem.

While conditions are unusual on these locomotives, a considerable amount of attention at terminals is now required to maintain the crossheads and guides on heavy modern power so that the vertical play of the crosshead shall not exceed ¼ in. and the lateral play shall not exceed 5/16 in. The manner in which the problem has been solved by the Pennsylvania should thus be of interest to many other roads.

In order to secure a material increase in the bearing area over the amount possible with either the usual Laird or the alligator type crosshead and thus eliminate the necessity for frequent repairs, the Pennsylvania in September, 1920, designed and applied to an L1s, or Mikado type, locomotive an



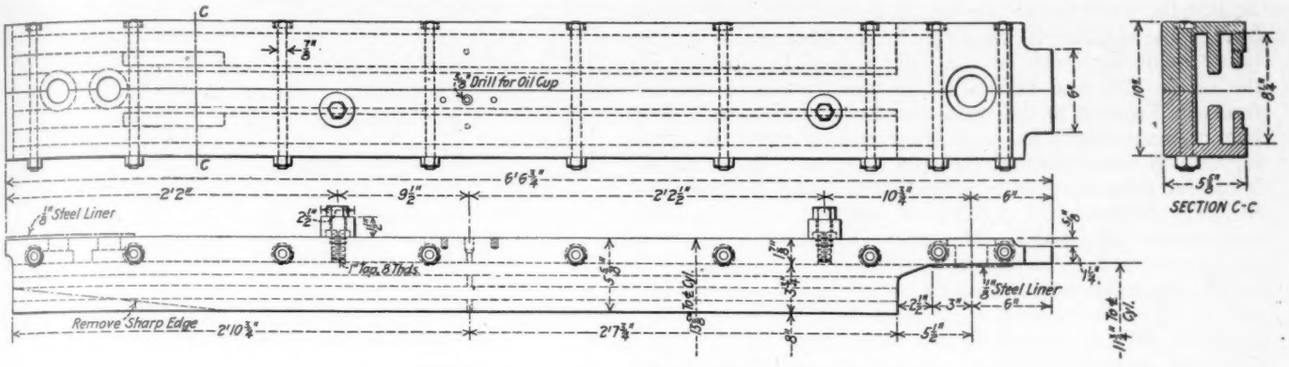
New Design of Crosshead for I1s Decapod

experimental set of unique guides and crossheads, with double longitudinal bearing ribs, a modification of the type used on the K4s (Pacific type). These particular crossheads on the L1s were 28 in. long and had a bearing area between crosshead and guide of 490 sq. in. on the upper side—divided between three planes—and 266 sq. in. on the lower side—divided between two planes. The experimental crossheads have proved highly satisfactory in service, having increased the average time between relining from 60 days to 360 days. As a result of these tests, the same general type has been made standard for the new I1s Decapod locomotives, of which 475 have been ordered recently.

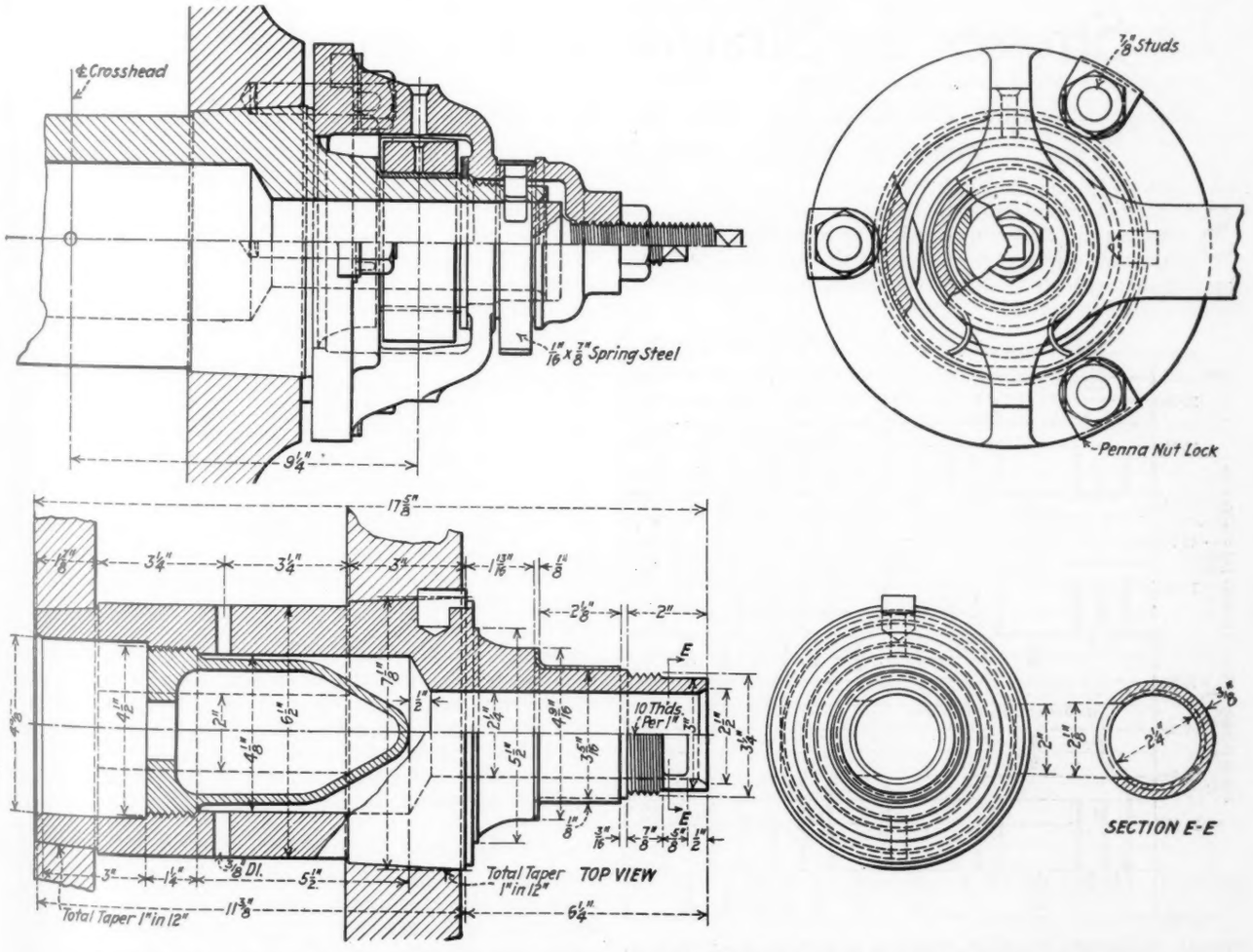
The guides and crossheads for these new locomotives are shown in the accompanying drawings. As will be noted, the crosshead has two bearing ribs or flanges, 35 in. long. These provide an area of 726¼ sq. in., not counting radii, for upward thrust and 376¼ sq. in. for downward thrusts. Neglecting the weight of the crosshead and rod, the vertical

thrust of 22,000 lb. on the crosshead thus results in an upward pressure of 30.4 lb. per sq. in. when the locomotive is going ahead and a downward pressure of 58.5 lb. per sq. in. when the locomotive is backing up The weight of each crosshead is 875 lb., including the pin. The guides are parted longitudinally along the center line for ease in machining, the two halves being securely bolted together after they have been finished.

The former I1s locomotives had crossheads of the alligator type which were 35 in. long with guides 9 in. wide. This gave an area of 315 sq. in. for either upward or downward thrusts, and a pressure of 69.8 lb. per sq. in. The bearing areas of the new standard crossheads consequently are 230 per cent of that of the old design for upward thrusts and 120 per cent for downward thrusts.



Guidance for Pennsylvania I1s Decapod Locomotive

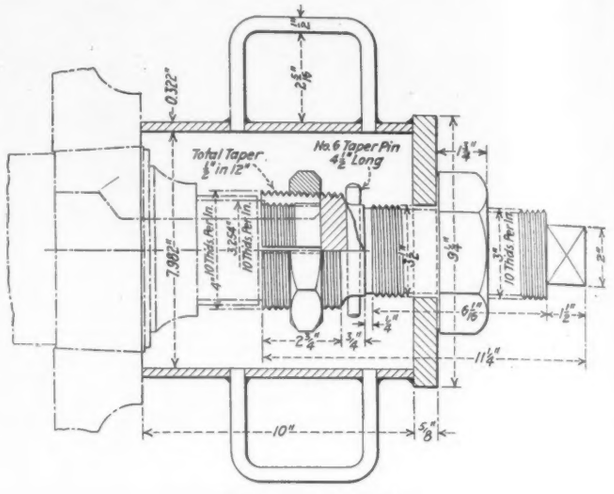


Grease Lubricated Crosshead Pin with Bearing for Union Link Removable from the Outer Side of the Crosshead

The crosshead pin used on the I1s locomotives is also of a new design which combines many desirable features. Because of the high piston thrust the bearing has been made

6½ in. by 6½ in. and the pin has been hollow bored to make it as light as possible. At the outside the pin extends beyond the crosshead to form a bearing for the union link.

The pin enters the crosshead from the outside and is held in place by a steel retainer casting which is drawn tight against the shoulder on the pin by three studs in the crosshead. In addition to securing the crosshead pin, the retainer holds the collar at the outer end of the bearing for the union link and carries the plunger which is used to force hard grease to the main crosshead pin bearing. The bore of the pin is closed at its inner end by a cast iron casting, which when screwed into place, reduces the space allowed for grease and at the same time provides a passage for the grease which is fed to the front and the rear of the bearing by two ¼-in. holes. The grease is inserted in the bore of the pin through a slot in the retainer casting which is covered by a flat steel spring to exclude dirt. The retainer casting is provided with a threaded hole which is in engagement with the thread on the grease plug shank, so that there will be no difficulty in starting the compression of the grease, irrespective of the amount of grease in the cavity. This construction will prevent damage to the threads which hold the grease plugs in place and the loss of the plug. The crosshead pin can be removed by taking off the retainer, placing puller and yoke which are shown in the last drawing, over the projecting end of the pin and screwing a nut on the 3-in. diameter threaded portion at the outer end.

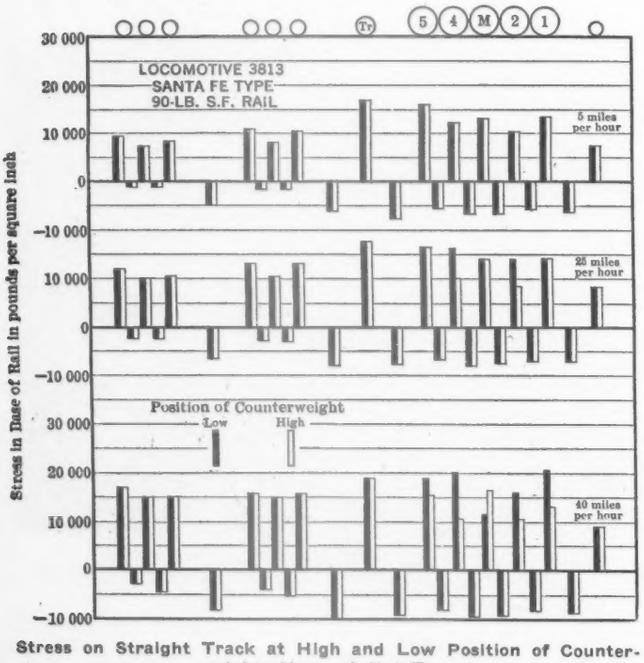


Crosshead Pin Puller

Stresses In Straight and Curved Track*

Joint Committee of American Society of Civil Engineers and American Railway Association Presents Progress Report

SINCE its organization in 1914, the Joint Committee on Stresses in Railroad Track has been carrying on an extensive series of tests to determine the stresses set up by different types of locomotives when operated at various speeds. The first progress report was submitted in 1918. This was followed by a second report in 1920 and a third report in 1923, of which a brief abstract is given herewith. The committee will continue the tests and investigations, the results of which will be presented as further information is obtained.



Stress on Straight Track at High and Low Position of Counterweight—Heavy 2-10-2 Type

*Report presented at the annual meeting of the American Society of Civil Engineers, New York, January 17, 1923, and the annual convention of the American Railway Engineering Association, Chicago, March 13, 1923.

The work reported herein includes tests on straight track and curved track. In the tests on straight track, consideration was given to the effect of counterbalance, the effect of speed and the combined effect of speed and counterbalance, and the lateral bending moments and stresses in the rail. In the tests on curved track are taken up the general action of curved track as the locomotive traverses the curve, the magnitude of the vertical bending stresses in the rail and the corresponding vertical loads producing them as contrasted with the normal loads, the lateral bending moments and stresses under the several wheels, the distortion of the alinement of the curves, and the general effect of speed, degree of curve, and super-elevation. The tests were conducted on the Illinois Central, the Delaware, Lackawanna & Western, the Atchison, Topeka & Santa Fe, and the Southern Pacific. In the tests, 13 locomotives of eight distinct types were used. In several types, there were variations in the design of the locomotives of the different railroads. The report is presented under the heads of Tests on Straight Track and Tests on Curved Track, covers 162 pages and records the results of 470,000 readings of operations.

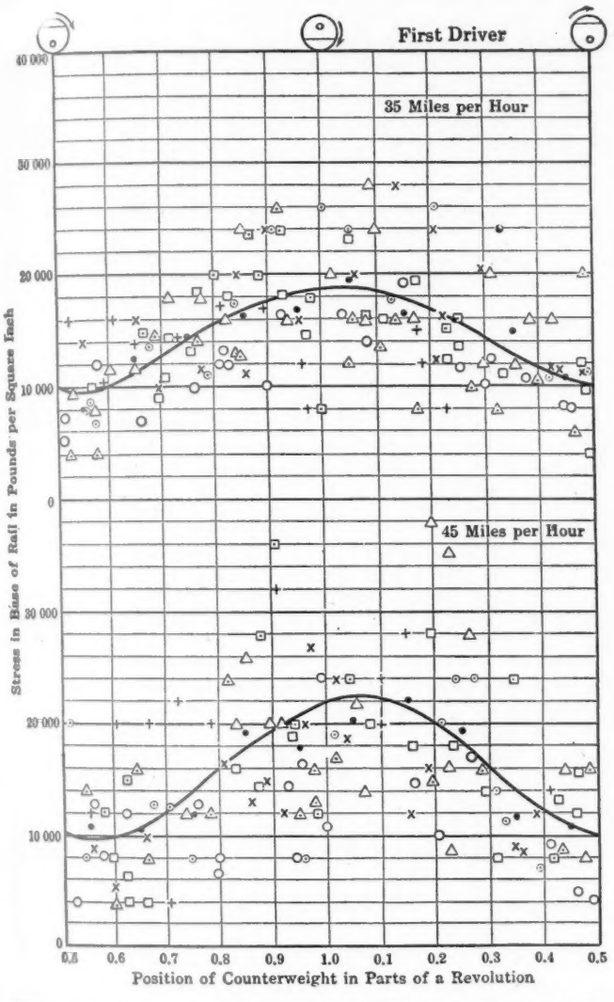
Effect of Locomotive Counterbalance

As may be expected, at a speed of 5 miles per hour, the variation in stress due to other causes is so much greater than that due to the effect of counterbalance as to mask any effect of counterbalance.

From the data it was noted that the highest stress in the rail under the main driver in all the locomotives except the Pacific type of the Delaware, Lackawanna & Western and the Balanced Compound Prairie type of the Atchison, Topeka & Santa Fe occurs when the counterweight is up. For several of the locomotives, a calculation for the counterbalance in the

main driver would indicate that, in many cases, the high stress may be expected to occur when the counterweight is down, if the method of calculation is that so generally used of neglecting the effect of the plane of motion of the main rod and other outside rotating parts not being coincident with the plane of motion of the counterweight and wheel and rail, whereas, the opposite condition may be shown by the results.

In general, for all the locomotives except the Light Santa Fe type, the stresses attributable to counterbalance at the highest speeds run, which in some cases were greater than the scheduled maximum speed allowed for the locomotive, are less than 5,000 lb. per sq. in. and, in most cases, considerably less than this. The counterbalance effect at the highest speeds used may be said generally to be not more than 30 or 40 per cent of the average stress in rail at 5 miles per hour; in some few cases, it runs higher; but, in most cases, it is lower. A counterbalance effect of 30 per cent will not be considered to be excessive, and the only question is whether the scheduled speeds are likely to be exceeded very much. It is seen that an increase of speed of 25 per cent will increase the counterbalance effect by 56 per cent of itself, and an increase of speed of 41 per cent will double the counterbalance effect. It is evident that great care must be exercised to prevent the scheduled limits of speed being exceeded very much if the stresses due to counterbalance are to be kept within moderate bounds. It is also clear that every care should be taken in the design, construction, and maintenance of the proper counterbalance, and checks should be exercised to insure that the conditions of counterbalance are known with certainty, as it has frequently happened that the counterbalance effect has varied from the reported or expected condition. Attention should be given to the main driver and a careful determination made of the effect of the outside rotating parts not being in the plane of the wheel and counterweight.


First Driver
35 Miles per Hour
45 Miles per Hour
Stress in Base of Rail in Pounds per Square Inch
Position of Counterweight in Parts of a Revolution

Observed Values of Stress on Straight Track, Light 2-10-2 Type

Effect of Speed and Combined Effect of Speed and Counterbalance

With the exception of the Light Prairie type and the Light Santa Fe type, the general increase in stress in rail under the drivers due to speed alone in changing from 5 miles per hour to the highest speed used in the tests ranges from 15 to 27 per cent, which may be called a moderate and allowable speed effect. With the same exceptions, the maximum speed effect under any one driver ranges from 24 to 30 per cent. For these locomotives and these tracks, therefore, the increase in stress in rail due only to the change in speed noted may be said generally to be less than 35 per cent.

For the combined effect of speed and counterbalance for the same locomotives for the maximum speed used, the range of general total increase in stress in rail is 30 to 53 per cent, and the maximum increase under any driver ranges from 43 to 80 per cent. The stresses in rail at the maximum range from 20,000 to 29,000 lb. per sq. in., in the three sections of rails used.

Speed, in miles per hour.	Position of counterweight.	Trailer. 2	Trailer. 1	Driver Number. 5	Driver Number. 4	Driver Number. Main.	Driver Number. 2	Driver Number. 1	Front truck wheel.
5	Mean value	9 200	8 900	9 500	11 400	11 100	11 900	11 900	11 700
25	Up	.....	.....	9 000	10 500	15 500	11 000	12 500	.....
	Down	.....	.....	12 500	14 500	9 000	15 000	15 000	.....
	Mean value	10 400	10 100	10 100	13 400	12 200	13 000	13 900	12 400
40	Up	.....	.....	10 500	9 500	20 000	11 000	12 500	.....
	Down	.....	.....	14 500	15 500	10 000	16 500	16 500	.....
	Mean value	11 500	11 100	12 400	13 800	13 900	14 000	14 900	13 800
Calculated stress under static load.		8 700	7 500	12 600	9 500	10 000	11 300	14 500	8 600
Calculated additional stress due to counterbalance at 40 miles per hour		.....	.....	+3 700	+3 600	-2 800	+3 600	+3 700	.....

Stresses with 2-10-4 Double Trailer Locomotive on Curves

Principal Values of Increase in Stress in Rail at a Given Speed Over the Stress at 5 Miles Per Hour

The Increase Is Given in Percentage of the Stress at 5 Miles Per Hour

Type of locomotive	Drivers: Speed alone, General value	Drivers: Speed alone, Maximum under one driver	Drivers: Combined speed and counterbalance, General value	Drivers: Combined speed and counterbalance, Maximum under one driver	Trailer	Tender wheels, General value	Tender wheels, Maximum under one wheel
Atchison, Topeka & Santa Fe Railway: Pacific, 60 miles per hour	27	30	53	53	15	75	93
Balanced Compound Prairie type, 50 miles per hour	15	26	30	43	29	50	87
Mountain, 60 miles per hour	20	30	35	50, 55	10	40, 60	110
Light Santa Fe, 45 miles per hour	40	77	105	190	10	25	35
Heavy Santa Fe, 40 miles per hour	18	28	50	80	15	75, 70, 50	110
Delaware, Lackawanna & Western Railroad: Facific, 60 miles per hour	20	24	42	59	14	45	57

Stresses With Experimental Four-Wheel Trailing Truck

The placing of a four-wheel trailing truck under a heavy Santa Fe type locomotive, thus converting it into a 2-10-4 type, for the purpose of learning experimentally the effect of this form of construction in changing the stresses in rail under the trailers and under the drivers was a novel undertaking that gave results of much interest. Although the double trailer was put in one of the regular locomotives and

thus the design did not have all the proportions which would be desired in a new design, it gave very successful results and decreased the stresses under both drivers and trailer, at the same time working smoothly and satisfactorily. The introduction of the double trailer brings a marked change in the distribution of stress under the several wheels of the locomotive. The stress in 90-lb. rail under the trailer of the 2-10-2 locomotive is changed from 16,900 lb. per sq. in. to 9,000 lb. per sq. in. under each trailer in the 2-10-4 locomotive. Considerable load has evidently been removed from the last three drivers as the stress at 5 m.p.h. was decreased 40 per cent under the fifth driver. With these changes has come an increase of 60 per cent in the stress under the wheel of the front truck, although the resulting stress is not especially high on the straight track. Under the trailers, the effect of speed is to increase the stress 25 per cent, in the change from 5 to 40 m.p.h. Even at 40 m.p.h., the stress in the 90-lb. rail under the trailers is only 11,300 lb. per sq. in. and the stresses under the drivers (not including the effect of counterbalance) are only about 13,700 lb. per sq. in. The stresses indicate a smoothly running locomotive on straight track.

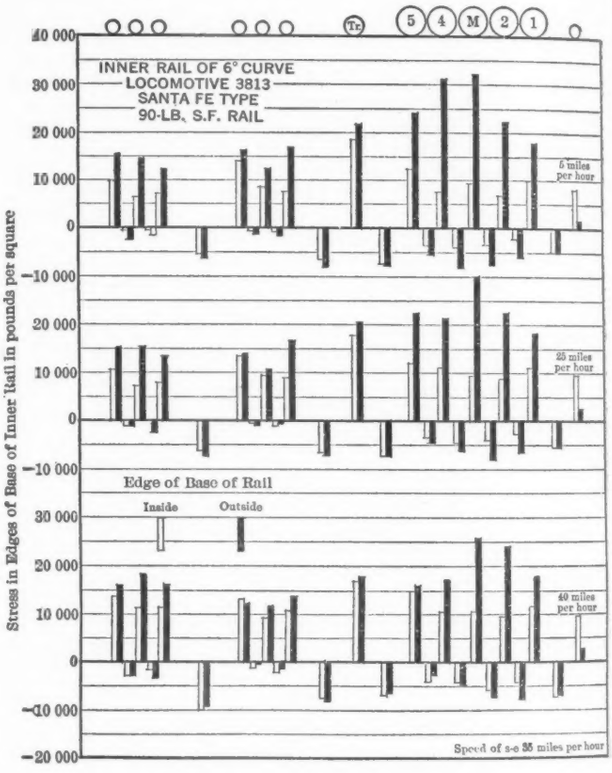
Result of Tests on Curved Track

The outstanding result of the study of vertical bending stresses on curved track is the variable distribution of load among the drivers, and, particularly, the greatly increased loads found on some of the drivers beyond that normally expected. These high loads occur principally on the inner rail and are most marked at the low speed, although high values were found in a number of cases at speeds two-thirds that corresponding to the super-elevation. Further examples of high loads under individual drivers at moderate speeds occurred in the tests in California. Loads ranging up to 100 per cent in excess of the normal load were found with several of the locomotives. These excessive loads produce high stresses in the rail, but more important still they give very high bearing pressures on the rail. As the bearing pressures found are considerably higher under some of the wheels than those which ordinary analysis of the effect of transverse inclination of track and centrifugal force would predict, it would seem well to have a study made of the action of the equalizing levers and the springs on curved track to try to find the cause of the concentration of load, and to attempt to modify the design so as to obviate such gross inequalities.

Lateral Bending of Rail on Curves

The lateral bending in the outer rail, under the wheels of the front truck, is found to be always positive (indicating an outward thrust) and it is generally positive also in the inner rail. This is true at all speeds. It indicates that the flanges of the outer wheel of the front truck always have an important part in changing the direction of the locomotive when moving on curved track.

In the locomotive having two-wheel front trucks, the lateral bending of the outer rail at the outer front driver is positive at all speeds, with the exception of the Mikado type on the deg. curve, where the super-elevation is 8.5 in. With the locomotives having four-wheel leading trucks, the bending at the outer front driver is generally negative at the low speed, becoming positive at a higher speed, with the exception that it remains negative in the case of the Pacific type locomotive on the 7½ deg. curve. The outer rear driver gives a positive lateral bending in the outer rail (outward thrust on the rail) at all speeds, the one exception being the Pacific type locomotive on the 4 deg. curve at a speed of 5 miles per hour. At low speeds, all the other drivers generally give negative bending in both inner and outer rail, tending to straighten the rail. The principal exception is that the bending moment under the inner fifth driver of the Santa Fe type locomotive is sometimes positive. An increase of speed results in an increase of lateral bending in the outer rail, decreasing the value of the lateral bending stress if the bending is negative and increasing the stress if it is positive. An increase of speed results in a decrease in the lateral bending in the inner rail, the numerical value of the lateral stress decreasing when the bending moment is negative and increasing when it is positive. When the stress due to lateral bending is combined with that due to vertical bending, it will be seen that the resulting stress may be very great. This is the more marked because the high lateral bending stresses generally occur under wheels giving very high vertical bending stresses, much greater than those developed on straight track. Thus, for example, at the outside edge of the base of the inner rail of the 10 deg. curve under the fourth driver of the Santa Fe type locomotive, at 5 miles per hour, the

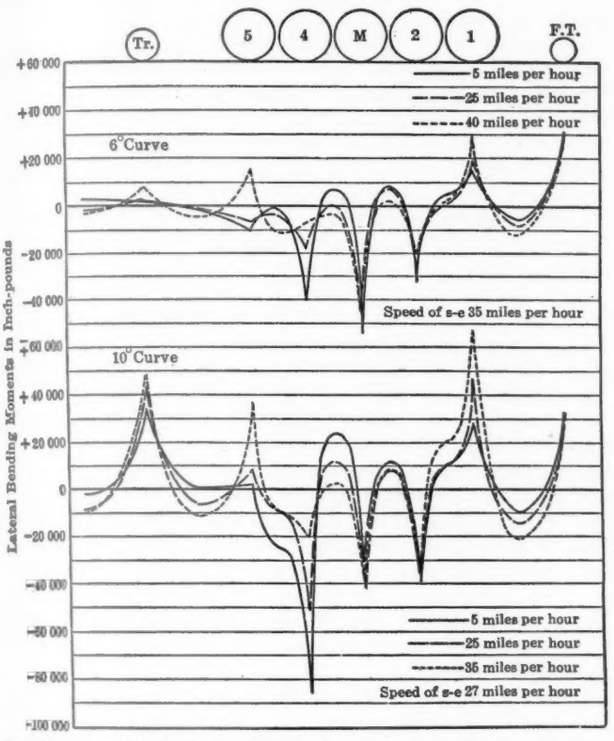


Stress at Edges of Base of Inner Rail on 6-deg. Curve—Heavy 2-10-2 Type

stress is the sum of 23,500 and 29,200, resulting in a stress of 52,700 lb. per sq. in. This value is the average of a large number of runs; not infrequently stresses several thousand pounds greater than this were found, indeed, one of 75,000 lb. per sq. in. was recorded. It may be added that the value of the lateral bending stresses under many of the wheels ranged from 40 to 100 per cent of the vertical bending stress under the same wheel.

The general trend of the combined bending moments under and between the several wheels is very striking. Intense and severe lateral bending action comes on the track as a whole as the locomotive passes around the curve, tending to push the ties and ballast first to one side and then to another and to throw the curve out of line. The ratio of the lateral bending moment in the inner rail under the fourth driver of three Santa Fe type locomotives (two of them belonging to the Atchison, Topeka & Santa Fe and one to the Southern Pacific) to the vertical bending moments developed at the same time averages 0.16 at the lowest speed on the 10 deg. curves. It should be recalled too that the vertical bending

stress under this driver was far greater than the normal and that the pressure of the driver on the rail must have been nearly twice the normal load. The ratio of the lateral bending moment under the same wheels to the vertical bending moment found generally on straight track averaged 0.04, although values as great as 0.14 were found. As the section modulus of the rail about a vertical axis is only about one-fifth that about a horizontal axis, the lateral bending stresses in the rail are relatively great in comparison with the lateral bending moments. It will be seen that the lateral bending effect on the 10 deg. curve under the fourth driver of this locomotive (taking the average value found) is at least four



Combined Lateral Bending Moments in the Two Rails of Curved Track—Heavy 2-10-2 Type

times the average value found on straight track and at least twice the highest value that may be expected.

Effect of Speed and Counterbalance on Curves

The effect of counterbalance on the stresses in rail on curved track is much more variable than that found on straight track. One interesting result of the study of the data is that, under a number of the wheels, the stresses at the outside edge of the rail showed marked effect of counterbalance, whereas those at the inside edge show almost no counterbalance effect.

The effect of speed on the division of the load of the locomotive between the two rails of the curve is quite another matter. At and near the speed of super-elevation, in most of the tests on curved track, the vertical bending stresses in the two rails do not differ much from each other. It may be noted that analysis shows that the speed may be increased considerably beyond the speed of super-elevation before the load on the outer rail would become equal to that imposed on the inner rail at low speeds. Although the ratio varies with the degree of curve and the super-elevation used, it may be said that for the track used in the tests the speed may be increased 30 to 40 per cent beyond that of super-elevation before the load on the outer rail may be expected to equal that found on the inner rail at low speeds. The foregoing discussion refers to the sum of the loads under all the wheels; the distribution of load among several drivers may be quite unequal, the vertical bending stresses in the rail under one driver of one type of locomotive being as much as double what might be expected in the case of the 10 deg. curve and 50 per cent more on the 6 deg. curve. The lateral bending stresses developed in the rails also vary with the speed. The lateral bending stresses in the inner rails are very great at the slow speeds, especially at the driver in front of the rear driver, and sometimes the one in front of this, in the case of the locomotives having eight and ten drivers. For medium speeds, say, up to two-thirds of the speed of super-elevation, the lateral bending stress under the rear intermediate driver continues to be of considerable magnitude. For the higher speeds, the lateral bending stresses under these wheels decrease markedly and at the speed of super-elevation the highest lateral bending stress in the inner rail may not differ greatly from the highest stress found in the outer rail. The greatest lateral bending in the outer rail under a driver is found at the outer front driver in those locomotives in which the wheel of the leading truck does not assume the principal part in changing the direction of the locomotive. With an increase in speed, this lateral bending stress increases. As the stresses in the outer rail under the wheels of the front truck do not increase with an increase in speed, it is evident that the greater effort to change the direction of the locomotive at the higher speeds is taken by the flange of this first outer driver.

Type of Locomotive

In the matter of changing the direction of the locomotive, it seems evident from the tests that the four-wheel truck of the Pacific and Mountain types presents advantages over the two-wheel truck of the Santa Fe and Mikado types. With the four-wheel leading truck used, the loads on the wheels are such as to give moderate vertical bending stresses. With the locomotives having the four-wheel trucks, there is little or no outward bending stress developed in the outer rail under the first driver, this driver participating in the turning action only at the highest speeds. With the two-wheel front truck, the lateral bending stress in the outer rail under the first driver may become very great.

Lateral Bending of the Rail Section

When a lateral force is applied to the head of the rail and the base of the rail is held in place either wholly or partly, it may be expected that the rail web will bend and the head of the rail will deflect outwardly or inwardly relatively to the original vertical axis of the rail. Measurable values of the lateral bending of the rail section were found. The deflection varied from zero to 0.016 in. The values on the 10 deg. curve were somewhat higher than on the 6 deg. curve. The Santa Fe type gave somewhat higher values than the Mountain type. As would be expected from the low speed used, the deflections were greatest in the inner rail, and the direction of deflection in the inner rail was generally away from the track. The direction of the deflection in the outer rail did not always correspond with the character of the observed lateral stress in the base of rail. As the lateral bending of the rail itself is the result of a number of forces, including those acting at the supports of the rail, it is possible that the sign of the bending moment at a wheel point may not be in keeping with the direction of the lateral force acting at that point. An interesting feature occurred when the Santa Fe type was backed over the track. A very high value of the deflection was observed in the inner rail under the fifth driver, a deflection of 0.016 in. away from the track for the 10 deg. curve, and one of 0.014 in. for the 6 deg. curve. The absence of leading wheels to guide the driving wheel-base is evident in these results. Values of the deflection as great as 0.007 in. were found at the wheels of the tender, the middle wheel of a truck on the inner rail giving large deflections.

Locomotive Boiler Water Circulation

Rate of Heat Transfer Depends on Rapidity of Water Movement Owing to Its Poor Conductivity

By C. A. Seley
Consulting Engineer, Locomotive Firebox Company

THE Babcock & Wilcox publication entitled "Steam, its Generation and Use," contains a chapter on circulation of water in steam boilers, showing by glass models of vertical and inclined tubes the circulation induced by various heat applications. Mr. Babcock makes the statement that if the surface of ice cold water was raised to boiling temperature, the heat would not begin melting the ice at a depth of three inches in less than about two hours. In this case there is no circulation at all and water of itself is such a poor conductor of heat as to give the result described.

Water circulation is a prime essential in a steam boiler for several reasons. Without it there will be little evaporation. For quantity evaporation every particle of water must be brought into contact with a heated surface and the only possible means is by moving or circulating the water particles against the heated surfaces. Each particle is not thus instantly converted into steam but it absorbs heat, raising its temperature, increasing its volume or decreasing its weight per unit of volume and enabling it, by the law of gravity, to assist in setting up, with its fellows similarly heated, an upward movement or current balanced by a downward movement of the colder particles.

These currents in various parts of the boiler combine to set up a general circulation of the water, dependent on the boiler design and proportions, and facilitate the gradual heating of the entire mass of water. As the highly heated particles again come in contact with heating surfaces they may absorb the final addition of heat which converts them to steam in the form of bubbles, now of greatly increased volume. We must bear in mind constantly that there is practically no conduction or radiation of heat in the water as between its particles, that no firebox or flue heat is transmitted to water not in contact with their surfaces, and that to fully utilize heating surface the steam bubbles as formed should be swept off and not allowed to linger. Another point is that by circulation the entire body of water is maintained at a more even and a higher temperature, resulting in a reduction of stresses in the structure which otherwise lead to maintenance trouble and expense.

No one will question the advantage of a large volume of highly heated water in operation. Every runner likes "a good steamer" and for that there must be proper water circulation and no sluggish areas. To obtain the highest evaporative effect each unit of heating surface should be swept by such a rapid circulation that steam bubbles are quickly removed from the surfaces after formation in a medium of so nearly equal temperature as not to condense the steam bubble in its path to the steam space. Furthermore, the more direct this path the freer the steam separation.

The evolution of the boiler from the day of the 8-wheel type engine has been accomplished without much attention to the matter of water circulation. It was largely automatic, the working out of a natural law which fortunately was in line with the needs and sufficed in the boilers of long past years.

The early boilers had a deep firebox set between the frames and a greater proportion of firebox heating surface relative to the small grate areas than is possible with boxes of later design in which the depth of water legs was materially reduced. The amount of water contained in the boiler was relatively small and the upward current in the deep legs induced an amount of circulation considered sufficient, if thought of at all.

With the need of increased power the boilers were made larger and longer and the volume of contained water greatly increased, with a tendency toward retarding circulation until, for another reason, arch tubes came into general use. But the arch tubes perform a very valuable function in stimulating water circulation. Being in the fire they are valuable heating surfaces, drawing water from the throat, to which the colder water in the belly of the boiler gravitates, and discharging mingled steam and water at steam temperature at the back head a few inches below the crown sheet. Thus the arch tube has been a lifesaver, so to speak, in boilers with long tubes or with deep combustion chambers.

Now, after 10 or 15 years in which the arch tube has come generally into use in heavy power, the report of the Committee on Design and Maintenance of Locomotive Boilers presented to the 1922 convention of the A. R. A., Mechanical Division, called for "Careful consideration of the design of boilers to the end of perfecting circulation of water." This seemed to imply that the question was still open, the last word not yet being said on improvement in that line. The discussion of the report brought out the fact that water leg devices in the past had been used in fireboxes, but as none seemed to remain or to have been developed to recognized standing, there must have been something wrong fundamentally, either in the manner of connection or in their relation to the direction of circulation.

Some 10 years ago, Dr. W. F. M. Goss made some locomotive boiler tests at Coatesville, Pa. Certain of the tests were made with the water and steam surrounding the firebox isolated from the water and steam in the barrel section of the boiler, the object being to ascertain the respective values of firebox and flue heating surface. When using oil as fuel, the results were 7.6 lb. of water per sq. ft. of firebox heating surface to 1 lb. of water evaporated in the barrel. For coal as fuel the results were 6.15 lb. to 1 lb. These boilers had 2¼-in. tubes, 18 ft. 2 in. long, about 3,000 sq. ft. of total heating surface, of which 206 sq. ft. were in the firebox, 58 sq. ft. of grate surface, and shells 70 in. in diameter at the front end.

The relatively high value of firebox heating surface for locomotive boilers shows one thing in relief; that the firebox is the place where, in proportioning the boiler, results of greatest value may be gained or lost. With the low value found for the flue heating surface it is evident that addition or omission of flues is not so material in the design at the barrel end as is consideration of lasting bridges, flue maintenance, circulation and water volume.

The high value of firebox heating surface is due to the combustion therein. The tubes are only about one-fourth the thickness of firebox sheets, but this advantage is lost because of the temperature reduction of the gases on entering the flues and because they are capable only of imparting heat by convection or rubbing on the tube walls.

Bureau of Mines Bulletin No. 18 gives the results of some very interesting stationary boiler tests from which the following points are noted. It was found that the resistance to the passage of heat through boiler plates was very small

as was that to the passage of heat to the plate and from it to the water if the surfaces are moderately clean, and that the heating plates transmit to the boiler water all the heat that can be imparted to their fire sides. With constant temperature of the gases, increasing their velocity over the plates increases the rate at which the plates transmit the heat and likewise increases the rate of steam making.

Here then is a plain case of the value of circulation of the gases. Based on the findings there seems to be a good argument for likewise stimulating the circulation of the water, whereby the water in contact with the heating surfaces may be so rapidly changed as to more effectively, thoroughly and evenly absorb and distribute the heat to the entire volume of contained water in the boiler.

During the Coatesville tests an attempt was made to measure the rate and direction of flow of the water in the boilers tested by special apparatus, but at only about a half dozen locations in a zone approximately central of the side water leg, 21 in., 45 in., and 69 in., above the bottom of the mud-ring. As no other locations are mentioned it is difficult to find support for certain assumptions made in the review of the findings, that "enough water passes back from the barrel to the water legs of the boiler to make good that which the firebox evaporates and no more." If that be true, I am wondering how a temperature reading of only 13 deg. below the boiling point was found at the lower back corner. The test showed a downward current in the leg on the outer side at the various points investigated but the high temperature noted would seem to be indicative of a fairly general circulation of the water, including the barrel content.

The water discharge of the arch tubes and of the water legs, at the sides and back of the firebox must create a head of water at the firebox. It is hardly possible that all of it is immediately converted to steam and if there is an additional head it must flow forward into the barrel and create a movement forward at the top of the barrel, due to its highly heated condition and the passage through it of the steam bubbles arising from the flue heating surface. But if the conclusion from these tests is correct it seems high time to consider means of inducing circulation from the barrel of the boiler, that there be no zones of sluggish movement and reduced temperature.

Circulation between the boiler and the Nicholson Thermic Syphon is brought about by the unbalanced head of the lighter weight of hotter water and steam in the syphon as compared with an equal volume of water in the barrel of the boiler, carrying out the law of gravity. Heat is the prime mover of water in a boiler and the movement, in a general way, may be said to be proportional to the amount of heat absorbed when bringing the water up to the boiling point. This is true also of the syphon and the circulation through it before boiling occurs is probably not more than twice as vigorous as in any other portion of the firebox well exposed to heat, taking into consideration that the syphon has both sides so exposed.

When making steam, however, a very different set of conditions obtains. Assume for example that the heating surface of a syphon will convert one cubic foot of water into steam in a certain time interval. The discharge from the syphon, then for the given time interval will include one cubic foot of water converted into steam, which would be a relatively small amount were it not for the fact that in its conversion to steam, say at 200 lb. pressure, its volume is increased over 115 times, therefore, in the time interval named above, space for 115 cu. ft. of water is made in the syphon and quickly supplied from the barrel of the boiler, as it is inevitable that the bubbles must go up and their place be taken by water from below. Thus a large flow of water is produced into and through the syphon, carrying with it the one cubic foot of water now in the form of steam bubbles weighing less than half a pound for each cubic foot.

It does not follow that the relatively large volume of flow through the syphon causes violent ebullition, nor is it constant in action except with uniform boiler conditions. The pumping action of the syphon depends mainly on heat absorption by the water passing through it and its conversion to steam. There is no doubt also of an induced action from the swiftly rising steam bubbles, pushing upward the water in the syphon.

It has been calculated that even without this induced action the water passes through the neck of the syphon at approximately four lineal feet per second, but because the discharge opening in the crown sheet is 10 to 12 times the neck area, the steam is quietly released. Calorimeter tests have shown exactly the same dryness of steam at the dome as on non-syphon engines. This quiet release at the syphon openings insures correct indications of height of water in gages and permits a generally lower water level with safety, with a corresponding increase and betterment of the steam space and steam quality.

It is one of the incidental advantages of the stimulated circulation caused by the syphon that mud and much of the precipitated matter are swept to washout points for convenient cleaning and keeping the boiler in a generally cleaner condition. Another advantage is a shortening of the time required in firing up. The saving of an hour has been demonstrated, plainly due to the stimulated circulation and additional firebox heating surface afforded by the syphon.

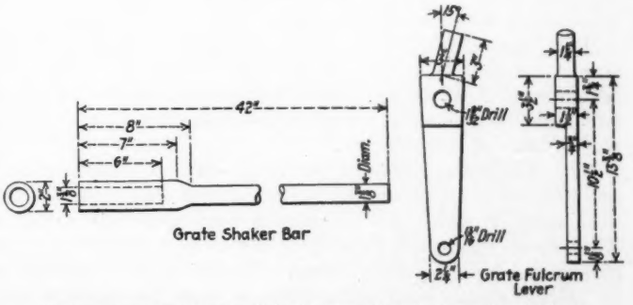
What has been said so far is altogether of a theoretical nature which may be very good so far as it goes, but the value in results is the proof of the pudding. Syphons have been furnished to 43 railroads of the United States for over 500 locomotives. A number of these roads have made tests of syphon equipped engines in comparison with others of the same class not so equipped. Results of a dozen or more road tests made by various railroads, about equally divided between saturated and superheated engines of the same classes, demonstrated coal savings on a 1,000 adjusted ton mile basis in favor of the syphon equipped engines ranging from 12 per cent to 25 per cent.

An Improved Grate Lever and Shaker Bar

By H. G. Bonney

Assistant Master Mechanic, Lehigh & New England

THE shaking attachments for grates, while simple and comparatively an unimportant feature of the locomotive, have been responsible for more injuries in the last three years than any other single part. According to the report of the Interstate Commerce Commission, the injuries caused by



Shaker Bar and Lever Adopted as Standard on L. & N. E.

grate shakers totaled 109 in 1920, 85 in 1921, and 49 in 1922. The matter was mentioned especially in the report of the Chief Inspector of the Bureau of Locomotive Inspection for the fiscal year ended June 30, 1922.

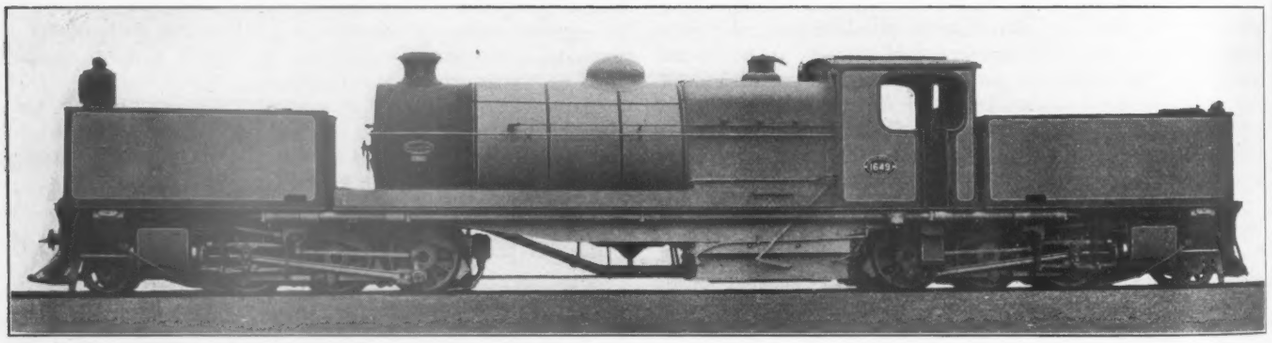
On the Lehigh & New England troubles with grate shak-

ers have been practically eliminated by a simple design of bar of the type shown in the illustration. The upper end of the grate fulcrum lever has a circular section 1¼ in. in diameter and 3 in. long on which the lever fits. The socket in the lever is 1⅜ in. in diameter. The absence of taper on either the socket or lever eliminates the tendency for the lever to work off when grates are being shaken. The shaker bars are all interchangeable and are easily made by welding a piece of seamless tubing to the end of a 1⅜-in. round bar.

Garratt Articulated Locomotives

THE provision of locomotives of great tractive force for mountain sections or for the haulage of unusually heavy loads is a problem which has to be met on many roads. When the requirements have been too severe for the conventional types, such as 2-8-2, 2-10-2, etc., the alternative so far used has been the Mallet articulated locomotive. There is, however, another form of articulated locomotive now in use in Australia, Brazil, South Africa and elsewhere, which offers certain advantages and is of interest as another solution of the problem. This is the Garratt type which was introduced in 1909 on the Tasmanian Government Railways. This locomotive was of the 0-4-4-0 type, 2 ft. gage, weight 71,700 lb., with compound cylinders and 16,250 lb. rated tractive force. Since that time the same type has been built for a number of other roads in several countries.

An example of a recent design of Garratt locomotives, shown in the accompanying illustration, was built for the South African Railways. These railways, which are of 3 ft. 6 in. gage, operate some of the most difficult sections of main line in the world. Continuous grades of 3 per cent are common, combined with uncompensated reverse curves of 19 deg., over which trains of 400 tons have to be handled at a speed of 10 miles per hour.



Garratt Locomotive of the 2-6-6-2 Type Built by Beyer, Peacock & Co. for the South African Railways

This locomotive, which is of the 2-6-6-2 type, was designed for freight traffic but has been used for heavy passenger trains. However, orders have recently been placed for two additional Garratt locomotives of the 2-6-2—2-6-2 type for certain passenger traffic.

The locomotive consists of three units: A boiler unit mounted on a girder frame carried at each end by an engine unit, each of which has a water or fuel tank built on to it. The pivot centers are located on the engine frames so as to give proper weight distribution. The Garratt locomotive is in reality simply two plain engines with one large boiler.

An important feature of the Garratt locomotive is the practically unlimited latitude permitted in the design of the boiler. The capacity may be all that is required, the grate area may be ample for even low grade fuels, while the volume of the firebox and the height from the grate to the crown sheet may be proportioned to give good combustion without resorting to an additional chamber. The firebox is thus a plain rectangular box—with a brick arch—constructed of three plates, tube plate, inner back head and wrapper sheet with but two seams and easily stayed. An unusual length of boiler barrel with long tubes is not required to give weight on the forward engine unit. As there are no axles underneath the ash pan, it can be of ample size and easy of access.

The distribution of the weight over the axles is positive, resulting from the location of the center or pivot castings. No weight adjusting links are required between the boiler and engine units and as there are no lateral control arrangements for centering the engine units, running is as free as with two separate small locomotives. The boiler unit when on a curve assumes the line of the chord instead of overhanging the outside as in the Mallet type, consequently high speed running is perfectly safe and a speed up to 60 miles per hour has been made on 3 ft. 6 in. gage track with 60-in. drivers. The Garratt locomotive is a true double ender and there is no need for turning at the end of the trip.

The South African locomotive shown weighs 299,650 lb. with tanks filled, of which 234,350 lb., or 78.3 per cent, is on the drivers. The load on any pair of wheels is less than 40,000 lb. The total length over couplers is 65 ft. 5 in., the length over pivot centers 33 ft. 3 in., the driving wheel base of the separate units 9 ft. and the total wheel base of the two units, 58 ft. 7 in. The driving wheels are 48 in. in diameter and the rated tractive force, 53,725 lb.

The boiler is 81 in. in diameter, carries 180 lb. steam pressure, has an evaporative heating surface of 2,554 sq. ft., of which 211 sq. ft. are in the firebox. There are 40 superheater units, Schmidt type, with 526½ sq. ft. heating surface. The grate area is 51.8 sq. ft.

The two engine units are practically alike with interchangeable cylinders, valve gear, rods, journal boxes, spring and brake rigging. The cylinders are 18 in. by 26 in. and develop 2,100 rated horsepower.

The ball joints of the live steam pipes are located directly under the pivot centers, being attached to the upper portion so that the ball simply rotates in its cup. The exhaust pipe ball joints are placed to one side and provided with slip joints to allow of the slight longitudinal movement.

Nine tons of coal and 1,250 Imp. gal. of water are carried in the combined tank on the hind engine frame, the shoveling plate extending into the cab, so that the foot plate arrangements are the same as for a locomotive with a tender. The front tank holds 3,350 Imp. gal. of water, the level of the two tanks being equalized by a large pipe placed outside the boiler frame and fitted with flexible connections to the elbow pipes under the tanks.

The majority of the Garrett locomotives at present running have been designed and built by Beyer, Peacock & Co., Ltd., of Manchester, England. They range from small locomotives for 2-ft. gage track to those on the San Paulo, Brazil, which are used on 5 ft. 3 in. gage track.

Water Treatment on Missouri Pacific*

By W. C. Smith

Mechanical Superintendent, Missouri Pacific, St. Louis, Mo.

THE experience of the past year has demonstrated clearly and beyond question the great advantage of careful attention to the quality of locomotive boiler water supply. It is recognized that the question of proper water supply is an individual problem in each instance. The Missouri Pacific, after experience with many varieties of proprietary compounds and also soda ash, adopted a constructive program for the improvement of the quality of its water supply by the elimination of the largest possible amount of impurities before turning the water into its locomotives. These experiences are not intended as representing recommendations for universal practice, but are submitted as information and it is probable that they may prove of benefit in suggesting a method which has effected large economy and materially assisted in the improvement of locomotive operation and maintenance.

The Missouri Pacific system operates over approximately 7,500 miles of railroad. It taps nine states extending from the Mississippi west through the plains of western Kansas to the Rocky mountains and from the Missouri river south through the Ozarks of Arkansas and the bayous of Louisiana. The characteristics of the water supply sources vary from the best to among the worst in the country. Water supply problems include the handling of the coal mine waters in Illinois, the muddy waters of the Missouri, the gyp and alkali waters of the Kansas plains, the salt waters from oil fields and the soft soda waters from southern deep wells. With such variety in the quality of water supplies the marked difference in effect upon engine performance and operation was noticed early. Trouble from scale with consequent leaking and short life of flues and fire boxes on bad water districts was a problem of the first importance. Various compounds and soda ash were tried out as internal treatments, but in most cases they resulted in an increase in foaming and involved the road in such heavy expense for a careful follow-up system, that it was decided to place reliance on more careful and reliable methods.

First Plant Built in 1905

Complete water softening plants were first installed in 1905. The terminals at Little Rock, Ark., Kansas City, Mo., Hoisington, Kan., and Wichita and Pueblo, Colo., were equipped and a number of intermediate stations between Poplar Bluff, Mo., and St. Louis and Bush, Ill.; also between Kansas City and Pueblo, about 32 stations in all. A summary for the year 1909 developed the following: Water treated, 312,234,000 gal.; scale removed, 591,000 lb. Compared to 1905, there was a 44.7 per cent reduction in engine failures due to leaky flues, etc., and also a reduction of 33.3 per cent in boiler maintenance and consequent increase in net tons handled per mile.

In view of these results and the large return on the investment, an appropriation was made for 18 additional plants to be installed in the bad water district west of Kansas City. Up to this time, the entire supervision for all plants had been centered at St. Louis, but it was found that the distance severely interfered with the obtaining of efficient and regular results, so in 1910 traveling chemists with small laboratories were located at Kansas City and Little Rock, these being central and convenient headquarters. This arrangement worked out very well and excellent results were obtained.

In 1917, eight additional plants were installed on the district between Hoisington and Pueblo, which completed the treating equipment at all water stations on this territory. The results obtained were so definite and satisfactory that the district from Kansas City to Omaha was similarly equipped in 1919 and 1920. Since that year the development has been continuing steadily until there are now 81 softening plants (including nine soda ash plants) in service and six additional plants are under construction. Of the total of 81 softening plants in service, 36 are of the intermittent type and 45 of the continuous type. Hydrated lime and soda ash are used for the removal of objectionable matter in supplies, except at the nine soda ash plants where treatment consists only in the removal of the incrusting sulphates.

The cost of chemicals used in treatment varies from 1.2 to 13.3 cents per thousand gallons depending on the quality of the raw water; an average cost is approximately four cents. The total average cost of treatment, including cost of chemicals, operation of plant, depreciation and supervision is approximately nine cents per thousand gallons. Installation costs for plants will vary over a considerable range, from $75 for the conversion of a roadside tank into a soda ash plant, to $22,000—the cost of some of the patented softening plants now on the market. An average cost for installations in use on this system is approximately $4,000.

Large Savings Effected

With the installation of six or eight more plants at some of the points of greatest consumption, it is expected that the quality of water on the Missouri Pacific will be very well in hand. Statistics for 1922 will show that there are 387 water stations in service. Approximately 7,000,000,000 gal. were supplied, of which 6,000,000,000 gal. were used for steam purposes. Of this amount, 2,400,000,000 was softened and approximately 5,000,000 lb. of scale removed which would otherwise have gone into the boilers, causing scale and its attendant troubles. It is estimated that a saving of 70,000 tons of coal was effected in 1922 by keeping this insulating coating from forming on the tubes and sheets. The saving in boiler maintenance engine time and in reduced engine failures has also been very large. It is estimated that the net saving, after subtracting the cost of treatment, will be in the neighborhood of $500,000, although the investment in treating facilities does not exceed $300,000. The intangible benefits such as the improved morale of the forces and the greater reliability of the power are factors which have also benefited greatly by these facilities but cannot be reduced to dollars and cents.

The following may be of interest, as being largely attributable to water softening:

	Increased life of flues and fire boxes	Reduction in boiler work	Reduction in engine failures due to boiler troubles
Little Rock district.....	150 per cent	45 per cent	40 per cent
Kansas City district.....	200 per cent	55 per cent	30 per cent
Wichita district	300 per cent	75 per cent	85 per cent
Hoisington district.....	300 per cent	65 per cent	70 per cent
Falls City district.....	100 per cent	40 per cent	30 per cent

An interesting feature was brought out on our Colorado division which runs from Hoisington, Kan., to Pueblo, Colo., 338 miles, and is divided into two engine districts at Horace. Before water treatment it was necessary to take out a "V" of flues every four to six months and clean out the scale, and to renew the entire set after 10 or 12 months' service. The flues in locomotive boilers are now run from 30 to 42 months. Instead of ¼-in. scale on the flues when they are removed there is less than 1/16-in. scale. An engine running on one district could not work on another without several weeks of bad leaky troubles but engines are now operated through from Hoisington to Pueblo without any difficulty.

On the district between Kansas City and Omaha, we formerly experienced considerable trouble with leaky staybolts, making it necessary to hold an engine for staybolt inspection and repairs about three days per month. Since the complete treatment of water supplies was put into effect

*Abstract of a paper presented before the Western Society of Engineers, Chicago, January 22, 1923.

we have practically eliminated the leaky staybolts and engines can be returned to service in much less time.

As an example of water treating results for stationary boilers at our Sedalia, Mo., power plant, where water is treated for five Babcock and Wilcox double-deck water tube boilers of 275 hp. each, about 650 of the 840 four-inch tubes were in service 12 years, using treated water. The raw water here contains about 20 grains per gallon of incrusting matter or nearly three pounds per 1,000 gal. and with its use untreated, tube failures were frequent and the scale heavy and very hard.

Many such individual instances can be cited but it is probable that any other railroad, which has given careful attention to its water problems, can do likewise. In fact, although we cannot say our scale troubles have been eliminated, they have been materially reduced. Also although engine failures from leaking have not been entirely eliminated, it is a fact that they are becoming very rare.

A factor which must be given attention in the correction of water supplies is the matter of organization and supervision. The best and most expensive apparatus will not give results unless operated correctly and regularly. If a water treating plant is not run properly it is worse than useless. Not only is the investment a loss but expected results are not secured and the entire plan is discredited. Only by careful and systematic organization and by placing definite responsibility, can good results be secured. The methods which have been established and worked out for taking care of these facilities on the Missouri Pacific are as follows:

The water supply supervision is centered in the engineering department, an engineer of water service being placed in direct charge. Small laboratories in charge of traveling chemists have been installed at Little Rock, Kansas City and Osawatomie, Kan. Samples of both raw and treated water are sent from each treating plant to the designated laboratory on each Wednesday and Saturday where tests are made promptly and reports are furnished to all concerned. Any indication of unfavorable tests results in an inspection of the plant on the ground. The treatments are governed largely by the inspection of conditions in boilers and the chemical tests are made to assure water being maintained in a condition found to be most favorable. The traveling chemists in the course of their inspection, consult freely with operating officers, general and division master mechanics, roundhouse and boiler foremen and others interested and any complaint is taken care of without delay. The engineer of water service and general boiler inspector co-operate with each other and all concerned. In this manner water troubles are adjusted and minimized.

A point which is always brought up in a discussion of water treatment is the question of foaming. It is a fact that as a general rule when a water softening plant is put in service considerable foaming complaint results. This is also more or less true when an engine is transferred from one district with one quality of water to another with different water. In most cases, this trouble stops after a few weeks. We have had some foaming trouble on the Missouri Pacific but with the use of an anti-foaming preparation, which is essentially a weak acid emulsion of castor oil made up by our chemical department, this trouble has been kept at a minimum.

The chief difficulty encountered with boiler waters at present is pitting and corrosion. The solution of this problem is still under study to determine the cause more exactly, but in this connection it can be said that while our present system of treatment has not eliminated this trouble, the improvement in conditions has been very marked.

In summarizing, permit me to emphasize again the importance of careful and conscientious study of water supply problems by a specially trained organization. This, together with close co-operation between the water service, operating and mechanical departments, will insure remarkable and satisfactory results and economies. Our experiences on the Missouri Pacific, where treating plants have been installed and properly supervised, have proven conclusively that these results can be accomplished.

Economics of Water Treatment*

By C. H. Koyl

Engineer Water Service, Chicago, Milwaukee & St. Paul

IN 1920, the Chicago, Milwaukee & St. Paul began the installation of water treating plants on the tracks east, west and south of Mitchell, S. D., where the water is very bad. We had had for some years a water treating plant at Mitchell, and one at Sioux City, and on the road had used all the anti-scale compound the boilers could carry; but in spite of all that had been done, the service was poor and expensive. On each engine district there were continuous boiler leaking and failures on the road every week; every boiler spent about two months in the shop every year, and averaged about $2,000 per year in heavy boiler repairs.

It is now two years since the first of the new plants were put in operation. Since then not one of the boilers using treated water exclusively has gone to the shop for boiler repairs. Because a successful effort was made to reduce the careless use of coal on the road not all the coal saving can be attributed to the treated water and my only means of determining this amount is to deduct from the total saving a percentage equal to that on adjoining divisions.

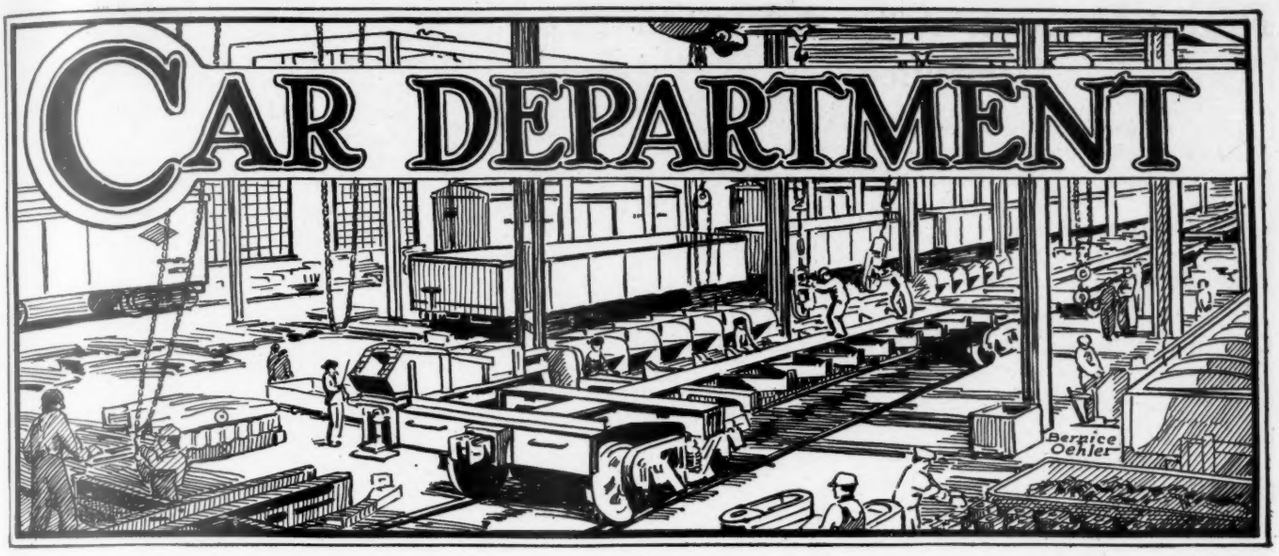
It was noted quite early that, whereas the division of 678 miles was saving 4,000 tons of coal per month, the 130 miles which was completely treated was saving three-quarters of the total, and the 548 miles of untreated water only one-quarter of the total. It was remarked also that about half the water treated on this 130 miles of east-and-west line was taken by engines of north-and-south lines crossing it; so that the good accomplished by the treated water did not all show on the record of the 130 miles, nor even on this division, but on adjoining divisions. And since the north-and-south engines which took water also took coal, our record of coal saved on this section of road was probably not more than half of the coal saved by the water treated there.

As the months went by, we found that the winter savings were far in excess of the summer savings, evidently because, with untreated water, the boiler failures and delays along the road were much worse in cold weather than in warm. As against the previous year, the freight trains carried 100 tons more load, each, and there was saved an average of 60 lb. of coal per thousand gross ton-miles, which was about 25 per cent. More than half of this was saved during the winter.

On the 14 engines operating on this line, at least $28,000 per year is being saved in heavy repairs and at least $12,000 in running repairs. On the same 14 engines, 600 tons of coal per month is being saved, which, at $4 per ton, amounts to $29,000 per year. This is a total of $69,000 per year saved in repairs and fuel. The other savings due entirely to treated water amount to at least $60,000 per year. This makes a yearly minimum saved of $129,000 due to the change from bad boiler water to good on a strip of road 130 miles long, where the water treating plants which effected the change cost $90,000 for construction and where the cost of treating the water is 12 cents per thousand gallons, or $7,200 per year for the amount used.

In addition to improved service on that 130 miles, and a reduction of $129,000 in operating expense, we have also released 3 of the 14 engines, whose construction cost was more than that of the water treating plants. And what is true on the 130 miles is true all over the treated water district.

*Abstract of a paper presented before the Western Society of Engineers, Chicago, January 22, 1923.



Comparative Cost of Spray and Brush Painting on Tank Cars

THE application of spray painting by a refinery to its tank cars recently afforded an opportunity for a comparative test of the cost of brush and spray painting. The material used was a scrap enamel, which pulled and was therefore difficult to apply with the brush. To overcome this, the

Applying Paint to Tank Cars With An Extension Spray

brush painters applied a heavier coat of material than was necessary.

Three cars were painted by each method and records kept of the time required and the paint consumption. The total time required to paint the three cars by brush was between 42 and 48 hours, and 21 gallons of paint were used. The three cars that were spray painted, using a De Vilbiss extension spray, were completed in five hours with a paint consumption of 10 gallons. The cost of brush painting was $15 a car, while the job was completed by the spray system at a cost of $4.17 a car.

The marked saving effected by the spray system in the amount of paint used is probably the result of the special character of the paint applied in this case and such a saving would not be obtained in the case of a freer flowing material. But the greater covering capacity of the spray coat, resulting from its uniform thickness always tends to reduce the amount required to a minimum.

Tank Car Specifications

The Mechanical Division of the American Railway Association has recently issued Circular D. V. 274 dealing with certain sections of the Tank Car Specifications.

Attention is called in the circular to trouble experienced in classification yards due to the failure of cast-iron plugs in the heads of tank cars. This is brought about by the use of hollow plugs, whereas Section 7 (b) of the Specifications for Class I, II, III and IV Tank Cars requires that such plugs should be solid and made of a good grade of cast-iron. An examination should be made of all tank cars as found practicable and solid plugs complying with the Tank Car Specifications substituted wherever the cored plugs are found in use.

Attention is called to a misprint in the first paragraph of Section 7 (d) of the Specifications for Class II Tank Cars as revised in 1922. This section should apply to both new cars and replacements, the first sentence reading: (d). Effective July 1, 1923, for *new cars* and replacements on existing cars.

In view of the approval by letter ballot of the recommendations of the Committee on Car Construction for a special center sill section for all new cars other than flat cars or cars with extremely low sides requiring fish belly type of center sills, Fig. 4 of the 1922 Tank Car Specifications, is withdrawn and an illustration showing the new center sill section is substituted therefor.

THE CAR PAINTING SHOP of the Canadian Pacific at Vancouver, B. C., was completely destroyed by fire on the night of April 10. Six pullman cars and adjoining freight sheds were also damaged, the total loss being estimated at about $250,000.

Recent Decisions of the Arbitration Committee

(The Arbitration Committee of the A.R.A. Mechanical Division is called upon to render decisions on a large number of questions and controversies which are submitted from time to time. As these matters are of interest not only to railroad officers but also to car inspectors and others, the Railway Mechanical Engineer will print abstracts of decisions as rendered.)

Cars Break Away While Switching; Handling Line Responsible for Damage

On December 16, 1921, while doing station switching, a brakeman of St. Louis-San Francisco train No. 42 attempted to hold three cars, placed on the main line, by placing a piece of wood under the wheels. These cars broke away and struck two cars attached to the locomotive, which at the time was moving back toward them preparatory to entering a siding. Missouri Pacific car No. 2807, which was between the locomotive and an empty box car, was broken in two. This is a 60,000-lb. capacity, eight sill, all wood flat car, claimed by the owners to be in good condition. It was not derailed and none of the other cars involved were damaged. At the time of the impact, the locomotive and two cars were slowing down but had not come to a full stop. The original wire report of the accident stated that the cars were moving at the rate of 10 miles an hour when damaged. The superintendent's completion report, rendered after an investigation, revised this estimate to from two to three miles an hour. The wrecking foreman reported the cause "unknown, not due to defective equipment." The St. Louis-San Francisco first asked the owner for the depreciated value of the car but later wrote the case up under Rule 120. The owner's contention is that the damage was caused under conditions defined in item (3), section (d) Rule 32, which makes the delivering company responsible for "letting cars get away on incline." The St. Louis-San Francisco contends that the speeds shown on both the preliminary wire report and the completion report are estimates of which the latter is more dependable since it is based on a thorough investigation, and that the fact that none of the other equipment was damaged shows that the speed was not the primary cause of the damage. It further contends that the type of construction of the car and the fact that it was not the car actually struck, proves that the damage was solely due to its light construction and weakened condition. It cited arbitration decisions Nos. 1123, 1148, 1182, 1185, 1195, 1196, 1197, 1198, 1204, 1205 and 1210 as covering this case and making the car owners responsible.

The decision of the Arbitration Committee states: "Damage to Missouri Pacific car No. 2807 was due to neglect on the part of the handling line to properly secure the cut of three cars against moving when set on main track. The handling line is responsible."—*Case No.* 1245, *Missouri Pacific vs. St. Louis-San Francisco.*

Responsibility for Cost of Transfer

On February 18, 1919, the Sand Springs Railway delivered Mobile & Ohio car No. 40760 under load to the Atchison, Topeka & Santa Fe. The Santa Fe inspector reported one center sill split and broken, one center sill split, draft bolt broken, one intermediate sill split, one needle beam split and one queen post missing. A request for authority to transfer the load was refused by the Sand Springs Railway. On February 27 a joint inspection was made, with the Santa Fe inspector present but not concurring. The report of this inspection showed one metal queen post missing, two draft bolts broken and one center sill split slightly, and stated "that the Atchison, Topeka & Santa Fe must accept the car and transfer it at their own expense and that there was no M. C. B. rule that held the Sand Springs Railway responsible." The Santa Fe transfered the load and billed against the Sand Springs Railway, which refused payment. The contention of the Santa Fe was, first, that the Sand Springs Railway was not under Federal control and therefore, the modifications of the M. C. B. rules (1918 code) did not apply to this case; second, that car service Rule 15 [Rule 2 (g)], makes the delivering road responsible for the cost of transfer on the showing of the joint inspection report, and finally that the joint inspectors exceeded their authority in rendering any "decision" beyond a statement of the physical condition of the car. It cited arbitration cases 913, 955, 1085 and 1142. The Sand Springs Railway set forth that since the car was in the yards of the Santa Fe which had the closest facilities to repair or transfer, to have repaired and transferred the car on the Sand Springs Railway would have required its movement to another point, causing a delay at a time when it was essential that the movement of freight be expedited. The Arbitration Committee decided that: "In the judgment of the receiving line, the defective condition of the car was such as to justify transfer in accordance with provisions of Rule 2; therefore, the delivering line is responsible for the cost of transfer."—*Case No. 1248, Atchison, Topeka & Santa Fe vs. Sand Springs Railway.*

The Relation of Rule 12 to Rule 91

On December 6, 1920, the Philadelphia & Reading applied an H type triple valve to Bessemer & Lake Erie car No. 80369. Charge for this repair was included in the December, 1920, bill, which was mailed January 12, 1921. When the car came home on January 14, 1921, a joint evidence card was made showing that it was equipped with the H type triple. On March 25, 1922, the B. & L. E. sent the repair card, dated December 6, 1920, and the joint evidence card, dated January 14, 1921, to the P. & R., requesting its defect card to cover the cost of making this repair standard. This the P. & R. refused to furnish, claiming that at the time the joint evidence card was issued the car owner had in its possession the billing repair card covering the original repairs, that according to Rule 13, it was at liberty to render bill for the correction of the wrong repairs if within the limit of one year, as prescribed by Rule 91, and that its failure to present the case so that defect card could be obtained within that time had outlawed the claim. The P. & R. further contended that the intent of the 16 months' allowance in Rule 12 was not to apply where not required to permit the correction of the wrong repairs and that Rule 91 should govern. The car owner maintained that the joint evidence card was obtained within 90 days of the return home of the card, that it was obtained and used within the time limits set by Rule 12, and that none of the provisions of Rule 91 become effective until after the defect card is furnished.

The decision of the Arbitration Committee states that: "In view of car owner having forwarded the joint evidence to the repairing line within 16 months, which is the limit set in Rule 12, fourth paragraph, the time required for rendering bill is a reasonable exception to the limit of one year prescribed in Rule 91. Therefore, defect card should be issued."—*Case No. 1250, Bessemer & Lake Erie vs. Philadelphia & Reading.*

A SPEED OF 233.87 MILES AN HOUR is the record of a flight of one kilometer, in a Curtiss aeroplane on the course at Wilbur Wright Field, Dayton, Ohio, on March 26, by Lieutenant R. L. Maughan.

Starting to Look Over the Train

Prize Articles in Contest on Car Inspection

Two Winning Papers Discuss General Inspection and Handling of Interchange

A LARGE number of articles on various phases of car inspection were received in the competition announced in the February issue of the *Railway Mechanical Engineer*. Practically all the papers contained valuable constructive ideas, and it required careful consideration to select the prize winners. After all the entries had been reviewed several times, the first prize of $50 was awarded to A. J. Mitchener, division general car foreman of the Michigan Central, St. Thomas, Ontario, for his paper on the Inspection and Lubrication of Freight Cars. The second prize of $35 was given to W. J. Owen, chief interchange inspector, Peoria & Pekin Joint Car Inspection Bureau, whose paper deals with Interchange and Industrial Inspection of Freight Train Cars.

Among others who submitted especially good papers were E. Erickson, New York Central, Chicago, Ill.; D. P. Crillman, Michigan Central, Detroit, Mich.; T. J. O'Donnell, Buffalo, N. Y.; M. H. Quinn, Port Jervis, N. Y.; Arthur Schafnitt, Birmingham, Ala., and N. J. Walsh, Union Pacific, North Platte, Neb. The two prize-winning papers are published herewith, and it is planned to publish other papers either complete or abstracted in succeeding issues.

The Inspection and Lubrication of Freight Cars

By A. J. Mitchener

Division General Car Foreman, Michigan Central, St. Thomas, Ont.

IN the inspection of cars the couplers, draft gear, air brakes and trucks are equally important factors in the safe and continued running of car to avoid accidents and delays.

Couplers

The finding of coupler defects which result in break-in-twos and derailments of trains requires careful attention by inspectors and repairers in train yard and repair tracks and to obtain results co-operation with the operating department and the car department is essential in reporting any partings in trains en route to terminal, to insure inspection and repairs of defective parts; also the use of the A. R. A. gage to locate couplers with more than the 5⅛ in. allowed in worn or distorted couplers or parts. The use of the gage is also imperative in gaging every coupler where opportunity presents in trains and repair tracks.

Draft Gear

Derailments due to couplers pulling out are largely due to draft keys working out, coupler pocket rivets breaking and broken coupler pockets. Inspection in train yards to discern and replace draft key pins, one or more broken pocket rivets or a top or bottom section of pocket fractured or broken will in many cases avoid a delay to the train en route and consequent expense of repairs on the road or chaining of the car to a terminal for permanent repairs.

Air Brakes

The maintenance of air brakes is a very important feature to insure proper handling of trains and prevent damage to equipment by undesired emergency applications of air brakes, brakes dragging and heating and cracking wheels and in some cases causing wheels to break and derail the car. To obtain this desirable condition careful test and inspection must be given all cars in train yards to locate any cars with porous or suspicious air hose and remove same; or brakes having excessive or short piston travel and where brakes do not apply and release properly. Where such defects cannot be remedied in train yards an air brake defect card should be applied and repairs made at the first opportunity. Such a card should prevent the car from being interchanged to a connecting road until the defects are repaired.

All cars passing over repair tracks should be tested with a standard testing set to locate defects in triple valve, cylinder and train line equipment and where triple valve repairs are necessary, the triple should be properly tagged and given a test on a standard test rack to insure proper repairs. All cars with stencilling over the 12 months allowed should be given attention on repair tracks and air brake equipment given cleaning and lubrication and proper test on completion. To insure careful observance of this feature a daily report from each repair point should be required showing the following:

Number of cars having air brakes cleaned,
Number of cars let go which were due for cleaning,
Number of air brake men working.

With this information a check of conditions can be maintained and force of air brake mechanics adjusted as necessary to obtain proper efficiency and the desired object in maintaining air brake equipment at 100 per cent.

Trucks

The inspection and lubrication of trucks is a very special and essential part of not only a train yard inspector's and oiler's duties but of repair track foremen and assistants as well. In train yards oilers should be required to spud journal packing well back under the journal. It is unnecessary to use a large amount of free oil and it should only be applied where necessary, as it is very evident that the lubrication is required at the back end of the journal, as cases of burnt off journals indicate that journals invariably burn off at the inside end and never at the outside end of the journal. If packing is in proper condition and well placed at the back end of the journal, no trouble will be experienced from lack of lubrication.

The originating point of a car should be the especial care of car department men, as too severe inspection and lubricating care cannot be given cars where loaded, and if such attention is not given at the originating point the car may possibly pass an inspection point a short distance from the point of origin and give every indication of running cool and when placed in a through train, develop hot journals in a short distance. Care should also be given to examine cars where hot journals are found to ascertain if overloaded. Where truck springs are fully compressed it is certain evidence of the car being loaded over capacity.

The examination of journal bearings to locate thin brasses is a point inspectors should follow closely. In changing brasses it should be ascertained that the wedge or box key is bearing in the center as a worn or distorted wedge or box causing the wedge to bear at the front or back of the brass will cause the journal to pick up strands of packing and a "waste grab" and hot journal is the result.

Careful tabulation of results obtained by inspection and oiling stations and monthly bulletining of such information to all points concerned is found to bring competitive results. When a man knows whether his efforts are bringing results and if improvement is being made, he is the more anxious to use every means in his power to increase the visible fruits of his efforts. To do this it is necessary to keep a record of the hot journals out of each inspection and lubricating point and the number of cars despatched, car miles, number of miles per hot box, and number of cars to every hot box, such information to cover the entire 24-hour period for the entire month and indicate the shifts and side of car upon which hot boxes developed after leaving the oiling station. Thus, it will show the number of hot journals out of each station, and the actual accomplishment of each point by shifts.

On the Canada Southern Division of the Michigan Central this arrangement has resulted in the past year in an average better than 40,000 miles per hot box, which, I believe, has not been equalled by any standard railroad in the United States or Canada. This figure is authentic and can be verified by records.

Cracked Wheels

The particular feature, however, is to locate and remove defective wheels from equipment, which condition can only be obtained by directing the attention of car inspectors and car repairers in the train yard, and car foremen and assistant car foremen on repair tracks, continually to the necessity of extreme care being given this particular feature.

Particularly is this true as regards the cracked wheel feature which is the most important and difficult defect in wheels to be located by an inspector or repair track foreman or assistant. This desired condition can be obtained by publishing monthly at each inspection and repair point on the division the names of inspectors and other employees who locate cracked wheels and also notify each man individually and complimenting him on each wheel found, thereby stimulating a competition to obtain the best showing by each individual man concerned. I have found this to be entirely practicable and for the past year I show the number of cracked wheels located on the Canada Southern Division of the Michigan Central:

March, 1922	36
April	107
May	153
June	92
July	85
August	135
September	132
October	189
November	154
December	126
January, 1923	279
February	175
Total	1,663

It is found that the men who become adept at locating cracked wheels are also very particular in finding other defective wheels, defects in couplers, out of gage, etc., cracked truck sides at inaccessible points and defective brake beams, brake hanger pins, etc.

The main argument, however, is the number of cracked wheels located as shown and whereas formerly scarcely any of these wheels were found as regular business, it is now a daily occurrence and wheels are being found which were overlooked prior to the inauguration of the system mentioned.

It might be well to state that no special means of locating these cracked wheels are used, simply care on the part of the men who handle the inspection and repairs of freight cars and the stimulus given the matter of general inspection in following out the system mentioned.

For the past year the points enumerated have resulted in 75 per cent of our bad order cars being located at terminal or grouping stations when cars are received on the division, thereby reducing the extra switching at intermediate points and the consequent delay in completing repairs. Also no serious derailments due to car defects have occurred during the same period. Following out the inspection methods explained has resulted in the use of two repair track tool cars for repairs to cars along the road, also the services of two steam derricks being practically dispensed with.

Interchange and Industrial Inspection of Freight Train Cars

By W. J. Owen
Chief Interchange Inspector, Peoria & Pekin Joint Car Inspection Bureau, Peoria, Ill.

Second Prize

ALL car inspection in the Peoria district terminals is performed by inspectors in the employ of the Peoria & Pekin Joint Car Inspection Bureau.

Immediately upon receipt of cuts or trains on interchange tracks they are properly protected at both ends by blue flag or light signals and the cars are then given a thorough interchange inspection, in accordance with the A. R. A. rules. At this time defect cards are issued to cover all cardable defects, empty house cars classified for loading, bad order cars carded and routed to the proper repair track, light repairs are made by inspectors or light repair men, and all necessary records made at the car.

Our system of interchange inspection provides for inspectors working in pairs, one on each side of a train, at points where the work justifies the maintenance of more than one inspector. Our methods include separation of air hose between all cars, opening of all journal boxes to insure proper examination of journals, journal bearings, etc. When possible, inspectors are stationed at the entrance when trains are entering the yard, in order to detect flat wheels as trains are passing.

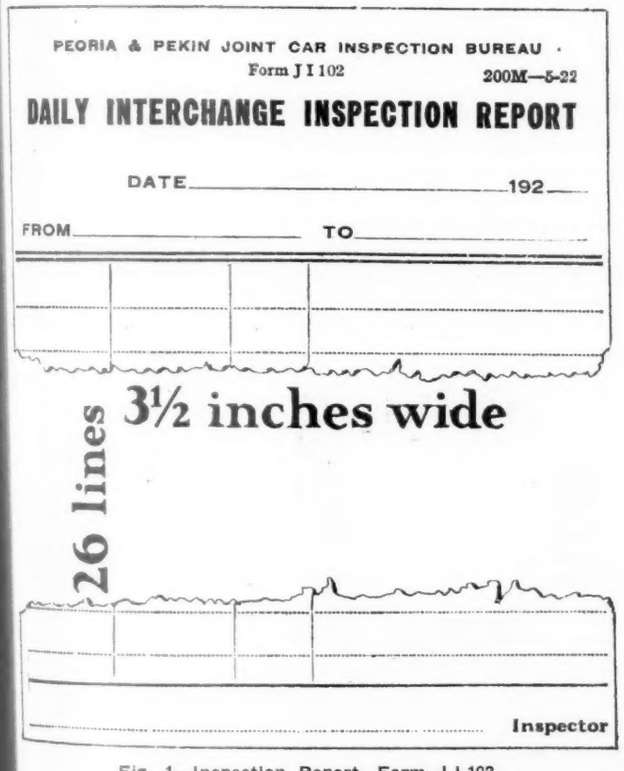


Fig. 1—Inspection Report, Form J.I.102

A top inspection is made of all house, stock, and refrigerator cars to determine the condition of the roof, running boards, handholds, brake staff, and attachments, also, an interior inspection of all empty gondola cars, as well as an examination of the lading on all open top cars, to ascertain whether there is any damage to lading or load depression, indicating loss of lading.

A thorough inspection is made of all safety appliances, couplers and attachments, center members, center bearings, side bearing clearances, brake rigging, trucks, etc.

A light colored pasteboard bad-order card, 4 in. by 8in., is used for all bad order cars. This card has the names of the parts of cars printed on both sides, with a space provided for the inspector to put a check mark in front of the name of defective parts. This saves a great deal of the inspector's time, as it avoids writing out the names of the various defective parts.

This card has two red bars ½ in. wide across the face on one side and a single red bar across the face on the other side. This card, when applied with the two red bars exposed, indicates to the switch crews that the car should be moved direct to the repair track. When one red bar is exposed it indicates that defects exist that do not render the car unsafe to move to a local industry to unload, or to a connection, but that the car must move to a repair track when empty and not be reloaded until repairs have been made.

Each railroad or switching line in these terminals is assigned an interchange number or pool mark and each car inspector an inspection number. All cars arriving in the terminal, inspected at industries and interchanged between connections, are pool marked on each side of the car upon the completion of the inspection. This pool mark designates the line delivering or receiving the car, the date of the movement, and the number of the inspector making the inspection of the car.

That the application of this pool mark has a very beneficial effect is evidenced from the results obtained, the inspector in pooling the car thereby signifying that he has inspected same, accepting responsibility for this inspection. Also, the application of pool marks assist the shop forces, in case a car is shopped for any defects; and the joint office, in checking the records and movements of cars.

All of our inspectors are required to make the following records on form J.I. 102, as shown in Fig. 1:

A—All defects on bad order cars.
B—Cars showing a visible loss of or damage to lading.
C—Defect card applied.
D—Foreign defect card data.
E—Wrong repairs to cars of member lines.
F—Repairs made to cars in yard.
G—Classification of empty cars.

All records are filed in a one-hundred pigeon hole case, the last two figures of the car number being the filing reference. To accomplish this it is necessary that a separate or individual inspection form 102 be made up for each car recorded under Items *A* to *E* inclusive.

Classification of empty box cars in interchange is filed by road reference, this report not requiring an individual record for each car, but an individual record for the cars of each line.

Under Item *F*, Cars Repaired in Yard, in addition to the form 102, the inspector making the repairs is required to execute the original record of repairs on the regulation work card.

As a check on the performance of each shift of inspectors at each point, performance sheet, form J.I. 103, shown in Fig. 2, is made up to cover the operations during each eight-hour period. At completion of inspection of each train the inspectors are required to enter on this form all necessary information on inbound or interchange trains or cuts, the road, train number, time of arrival, completion of inspection, number of cars in train, and number of cars marked bad order.

On outbound trains they must show the time the train was ordered, time made up, time inspection was finished, time engine coupled on to train, time air test was completed, and

time of departure; also, the number of cars in train and number of bad orders set out.

Where it becomes necessary to set cars out of outbound trains, or where trains are delayed, a full explanation is made on the back of form 103, showing car number and initial of car set out and nature of defects, or cause of delay.

Inspectors handling each train must show their numbers in the column provided. The additional information called for at the bottom of this form gives the office a full and complete report of the work done during any eight-hour period at each point.

These reports, form 103, are assembled in the office each day and compiled on form J.I. 147, Fig. 3, and each point's performance checked against an efficiency rating gotten up to cover the working condition of the various yards. Each point's rating is shown in the right hand margin under the item, "Percentage of Efficiency."

Method of Inspection and Classification of Empty Box Cars for Grain and Other Ladings

Car inspectors are directly responsible for the proper classification of cars; and the fitness of a car for loading any commodity can be determined only by a thorough interior and exterior examination.

For careful selection, inspection, and preparation of box cars for loading, to insure proper protection of freight, is of

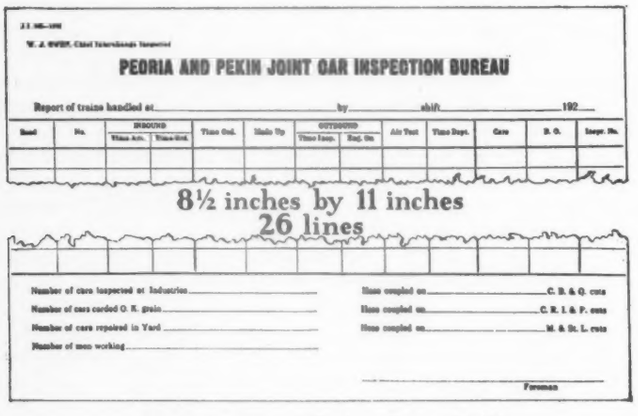


Fig. 2—Report of Trains, Form J.I.103

the utmost importance. The interest of both carrier and shipper is mutual in this respect, consequently, the use of unfit cars, even when the need may appear to be pressing, cannot be justified, as it usually means damaged freight, delays to lading and equipment, dissatisfied customers, and consequent losses to all parties concerned.

This bureau has a standard set of rules or specifications for the classification of empty box cars, a copy of which is furnished each inspector. This is necessary in order to bring about a uniform classification of cars by all inspectors. This standard specification for the inspection of empty box cars brings about a common understanding among all inspectors as to the proper classification of each car, thereby avoiding the reclassifying of many cars after being set to an industry for loading, and the elimination of any unnecessary switching or handling of the car.

A standard six-way commodity card, form J.I. 130, shown as Fig. 4, is used for all empty box cars, and folded to show the commodity for which the car is fit. These cards are securely attached to both sides of the car with two tacks. On cars that are fit for both flour and grain, or sacked feed and merchandise, they are folded diagonally to show both of these classifications. The folding of the commodity card in this manner, to show more than one class of lading, often eliminates an extra move or switching of the car.

Immediately upon arrival of empty box cars in these terminals, they are given a thorough inspection and are classified for industrial loading, as well as being given an interchange inspection, and the commodity cards, showing the

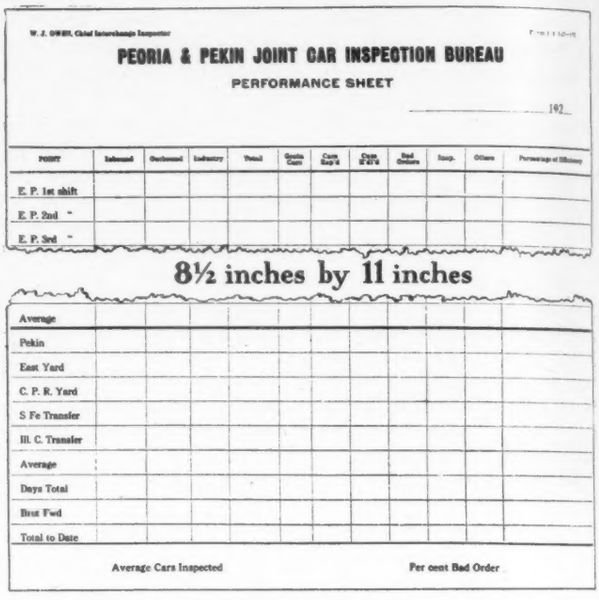


Fig. 3—Performance Sheet, Form J.I.147

classification, are applied at this time. All box cars unloaded at industries are immediately inspected when empty and the commodity cards applied.

A special record form, J.I. 102, is used by inspectors for reporting the classification of all empty box cars. This form is shown as Fig. 1. Where inspections are made at industries, the records show the location of the industries. Where such inspections are made at the time of arrival in the

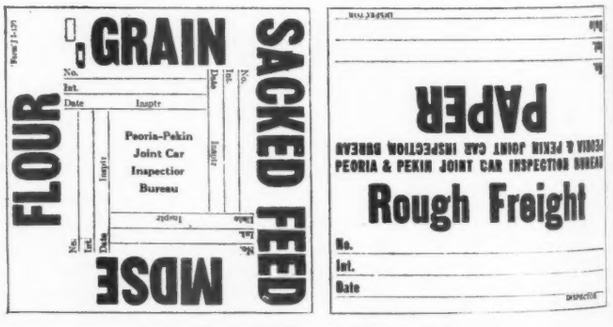


Fig. 4—Commodity Card, Form J.I.130

terminal, the record shows the train number, time of arrival, and the line delivering the car. In either case, the car number, initial, and commodity for which the car is fit, are shown on the record. Where cars are not fit for flour, or similar first-class lading, a notation is made on the record, showing the condition rendering the car unfit for a better class of lading. This record is mailed to the chief inspector's office and a copy is furnished by the inspector to the local yardmaster or agent in charge of that district.

The results of this system, of classifying all empty box cars on inbound inspection and the application of the commodity card, has been very satisfactory, as this method assists the transportation department in properly disposing of cars without any unnecessary switching, and the selection of only such cars as are suitable for loading at industries, or on special orders for connecting lines.

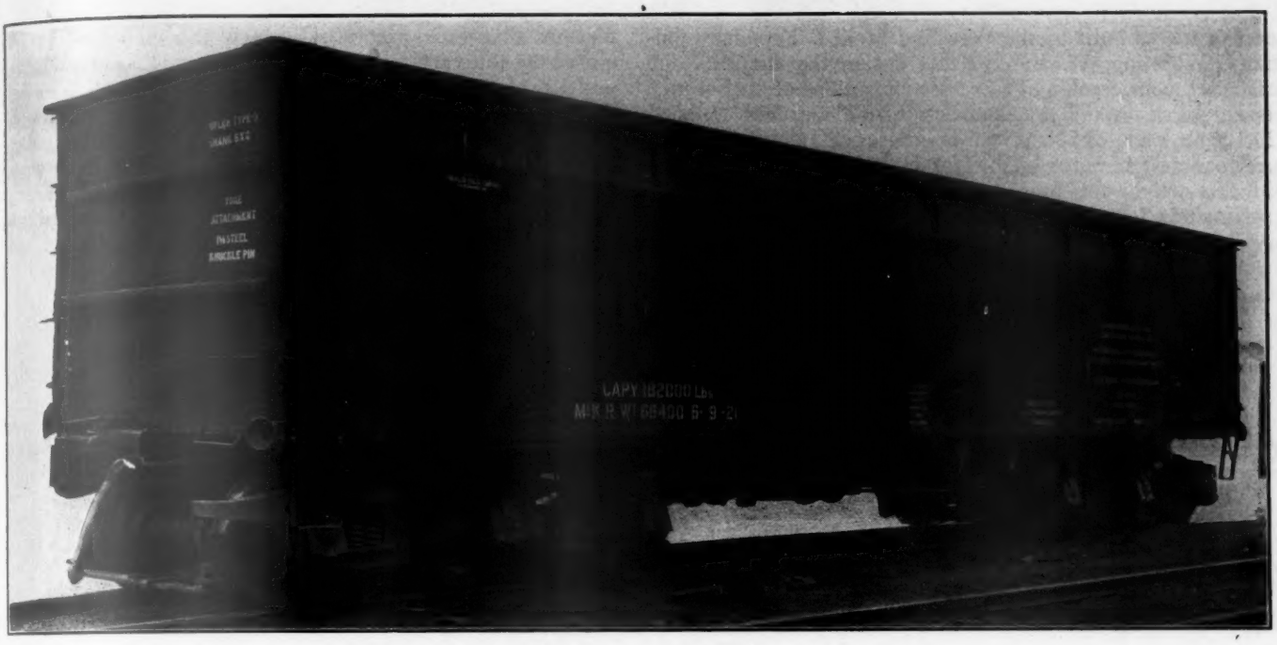


Fig. 1—100 Ton Gondola Coal Car with Boyden Six-Wheel Co-ordinating Trucks

The Boyden Six-Wheel Co-Ordinating Truck

Designed To Provide Extreme Flexibility in Order To Minimize Curve Resistance and Flange Wear

A SIX-WHEEL truck for freight cars, in which each axle is free to assume a true radial position when passing around curves has been designed and built recently by the Boyden Steel Corporation, Baltimore, Md. The object in developing this new type of truck has been to minimize resistance and wear of wheels and rails on curves at the same time providing a simple, durable construction easy to build and maintain.

The first Boyden co-ordinating truck was the conception of John C. Boyden. After a model had been made, a company called the Boyden Co-ordinating Car Corporation, Baltimore, Md., was organized to carry on the initial development work.

Drawings were completed, patterns made, castings produced and a full sized truck assembled at the Camden Iron Works, Camden, N. J., in 1919. This truck, which weighed 22,000 lb., was submitted to many tests to determine its action in passing around various curves.

Being satisfied from these tests that the principle of the design was a correct one, steps were next taken to build two trucks for further tests under a car. A number of modifications in the patterns used for the second design, which was intended for a 120-ton capacity freight car, reduced the weight of a complete truck to 19,600 lb. Castings were made by the Pittsburgh Steel Foundry Company and the trucks assembled at the plant of the Cambria Steel Company, Johnstown, Pa. They were placed under a 100-ton capacity coal car obtained from the Chesapeake & Ohio and, with the car loaded to its full capacity, runs were made around the sharpest curves and over the poorest track available at the car plant. This work was carried on in 1920 and 1921.

Following these tests the third design was made and a

Fig. 2—Boyden Six-Wheel Truck—Brake Rigging Not Applied

pair of trucks built by the Wheeling Mold & Foundry Company, Wheeling, W. Va., in this design the shape of the cast steel members was of a box section instead of an I-section as employed in the previous design. The trucks weighed 20,100 lb. each, complete with brake rigging, and as with the previous design were suitable for cars of 120 tons capacity. Of this weight the four main steel castings made up approximately 9,000 lb. The trucks were substituted for the older ones under the Chesapeake & Ohio 100-ton coal car in 1922 and the car placed in service. This is the design shown in the accompanying drawing, Fig. 3, and the photographs, Fig. 1 and Fig. 2.

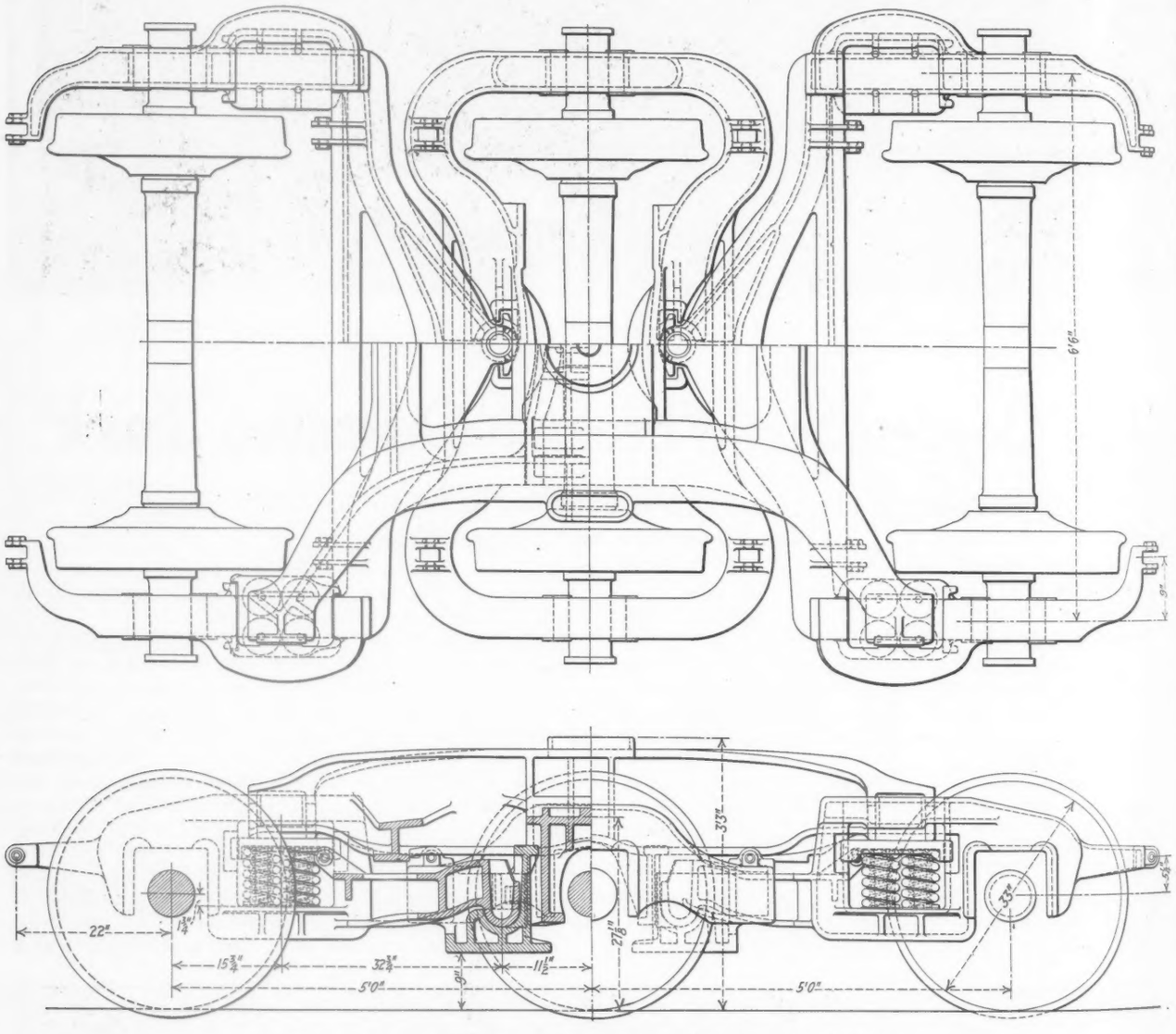


Fig. 3—Plan and Elevation of Boyden Six-Wheel Co-ordinating Truck

For an understanding of the principles and the operation of the Boyden co-ordinating truck, attention is directed especially to Fig. 4, Fig. 5 and Fig. 6. The truck frame consists of four substantial steel castings, a center frame, two end frames and a co-ordinating bolster, shown detached in Fig. 4. Wheels, axles, journal boxes, brasses, wedges, etc., are of the standard types now in general use. The center frame which carries the boxes for the middle axle contains two large sockets. Each end frame is provided with an arm and a ball joint which rests in the socket on the center frame. The three frames are thus so flexibly tied together that each pair of wheels is free to swivel as required by the varying curvature of the track. The relative position of the parts is indicated in Fig. 5, which shows the three frames with their journal boxes, wheels and axles on a curve. The co-ordinating bolster sets over the center frame and acts as a guide to the center axle. Its four arms rest on springs carried in pockets on the end frames. At each of the four points there is a nest of four double springs with a common upper spring seat. The location of the spring pockets is such that the weight is distributed equally between the different axles. The co-ordinating bolster is shown detached in Fig. 4 and in place in Fig. 6, the latter illustration showing the position occupied on a sharp curve. It is so designed as to permit its center to take a radial horizontal motion as well as a vertical motion to a degree sufficient to take up any irregularities in movement of the several parts of the truck. The truck may be described as consisting of two pony trucks placed back to back on a common supporting member and all parts held in co-ordination by a four-armed bolster frame.

The axles are placed 5 ft. apart, making the wheelbase 10 ft. Hanger brackets are provided for the support of the clasp brake with which the truck is equipped. Journal

boxes of standard design are bolted to the truck frames.

In working out the details of this truck the endeavor has been to produce a design of such flexibility that the car could be hauled around the sharpest curve with a minimum of resistance and consequently of rail and flange wear. The equalization of load, durability and accessibility of parts,

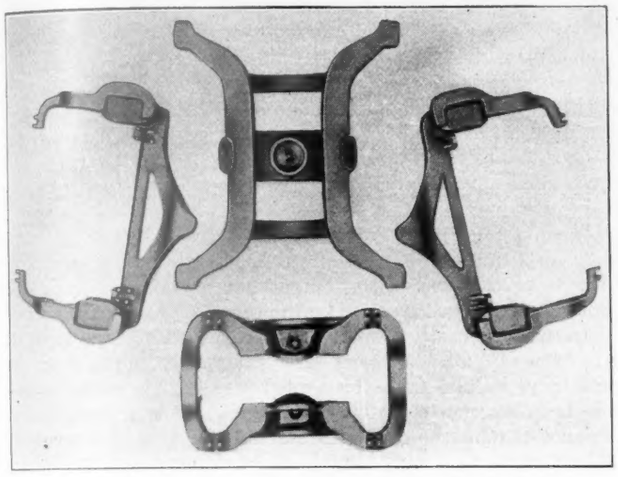


Fig. 4—Center Frame, End Frame and Co-ordinating Bolster

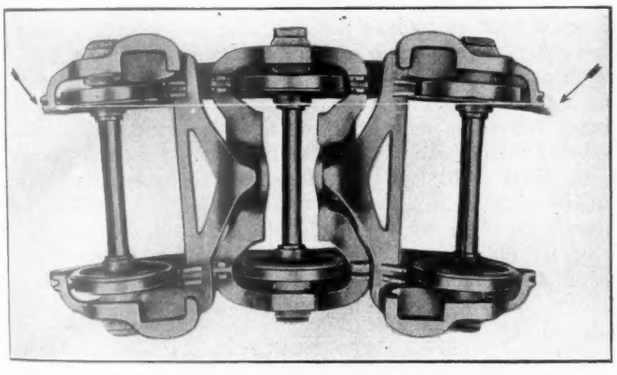


Fig. 5—Frames Assembled with Wheels and Axles Showing Position on a Curve

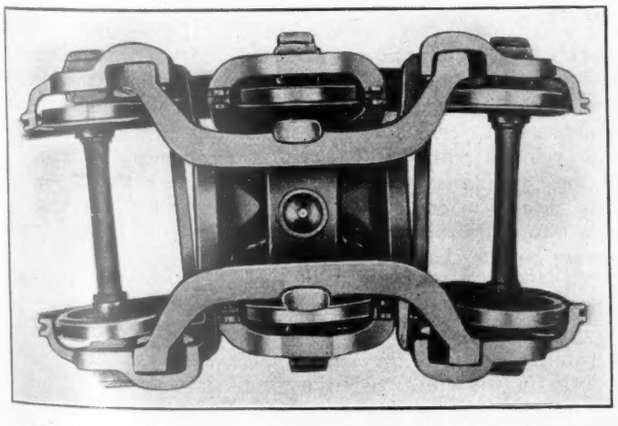


Fig. 6—Top View Showing Co-ordinating Bolster and Frames

simplicity of construction and ease of assembly, together with smoothness in running have also been considered.

After the car equipped with the last design of trucks had been thoroughly tested out around Wheeling, W. Va., arrangements were made for a test run under ordinary train conditions over the Baltimore and Cumberland divisions of the Baltimore & Ohio, the car running west as an empty and returning loaded. The run of 330 miles lasted from May 29 to June 2, 1922. A dynamometer car was attached ahead of the car being tested which was at the rear of the train, and observations made by a corps of inspectors. Speeds ranged up to 44 m. p. h. and in both light and loaded conditions the action of the car either on straight or curved track is said to have been very satisfactory. The vertical movement of the car body was reported as relatively slight with little rolling action. The car has since been in intermittent service on the Chesapeake & Ohio.

These trucks are now controlled by the Boyden Steel Corporation, Baltimore, Md., which has taken over the rights of the old Boyden Co-ordinating Car Corporation.

System of Delivering Material in Car Repair Shop

By W. W. Warner
Works Manager, Erie Car Shops, Kent, Ohio

UNTIL recent years it has been the practice in most repair shops for the individual workman to go to the storehouse and get his material as required. This practice results in a great loss of time. In most cases repairmen work in gangs of two to four men. Usually one or two of these men will go after material, while the balance of the gang takes a rest until the men return with the necessary material. The system also causes a congestion at times in the storehouse when a large number of workmen call at approximately the same time, with a resultant delay in getting the material from the storehouse force. The system also affords a workman an opportunity to get away from his work and visit with some of the other workmen, furnishing the excuse to his foreman when he returns that he was looking for material. The practice also results in wasting material, due to workmen drawing more material than they actually need.

In order to overcome the loss of time and the waste of materials in the shop of which the writer is in charge, an entirely new system was put into successful use about two years ago. This system consists of an organization including one leader, five truck drivers and five laborers with the following equipment: five electric trucks, three general service trucks of platform type, two tractors, and 10 trailer trucks. With this organization and equipment we are able to supply 400 workmen now employed in the plant.

Orders for the material required are filled out by the department foremen and placed in receptacles for this purpose, of which we have 50 placed at various points throughout the plant. The receptacles are all numbered and the foremen show both the receptacle number and the number of the car on which the material is to be used, thus giving the delivery gang complete information as to where the material should be delivered. The truck drivers have their regular route to cover and stop at each order receptacle at least once each hour to take up the orders.

In case there is a need for any particular item of material before it is delivered in the regular routine, the department foreman gets in touch with the leader over the shop telephone and gives him the information necessary in order to get immediate delivery of parts required. This system also assists in disclosing any shortage of material, as the leader turns over to the storehouse foreman each day any orders for material that is not in stock.

With the system as roughly outlined above, we are able to effect a considerable saving in time (which under the present rates amounts to over one cent per minute for all mechanics) as there is no waiting for material as was the case under the old system.

Standard Car Equipment for Indian Railways

By Fred Evans

THE Standard Wagon Revision Committee of the Indian Railway Conference Association has published a report, a brief summary of which may be of interest. Three years ago the committee prepared a number of car designs for the 5 ft. 6 in. gage and the meter gage railways and sample vehicles were built. The committee was retained to watch the action of these cars in service and afterwards to incorporate whatever improvements experience has shown to be desirable and eliminate any defects detected; also to work out designs for additional types of cars. The work of the committee is now represented by 16 standard, 5 ft. 6 in. gage cars and 20 standard meter gage cars, also by three standard passenger car underframes.

Simplicity and economy of construction have been special features the committee has attempted to embody in the new construction as well as facility in repairs. Small fittings and details, including hand holds, tarpaulin cleats and label holders have been standardized. In order to reduce loss by theft no loose fittings are employed. Journal box covers are henceforth to be held in place by studs which have a neck turned at the outer edge so as to prevent the stud being wrenched off, enabling the oil and waste to be stolen from the boxes. The loss of journal box covers and the theft of oil is serious in India. The only effective alternative would appear to be riveting the covers to the boxes. As far as possible, structural details, including doors and fastenings, have been standardized.

The Indian Railway authorities may in the early future take up the introduction of automatic center buffer couplers on their 5 ft. 6 in. gage railways; consequently the committee has given the point consideration, as several railways in other countries have substituted center buffer couplers in place of central screw couplings and side buffers. The screw couplings for wagons, in the opinion of the committee, should stand a tensile test of 100 tons as well as an impact test of not less than three blows, each of 5 foot-tons intensity; this has been rendered necessary by the increase in the weight of trains now hauled in India. With a stronger screw coupling failures in drawgears are not likely to happen so frequently.

As regards standard designs for three additional types of cars prepared by the committee, the cattle car for the broad gage is 21 ft. long and for the narrow gage 21 ft. 6 in. The tank cars are to be 23 ft. long, four-wheeled, for the broad gage, and 35 ft. long on trucks for the meter gage. The third type, vans for the conveyance of explosives, are to be 19 ft. 6 in. long for the broad gage, and 21 ft. 6 in. for the narrow gage.

Careful consideration has been given to the structural details of the tank cars. The committee has decided to discard safety valves and to substitute a 10 per cent space above the level of the oil. The tank joints are to be welded and there will be no outlets of any description at the bottom. The committee recommends that the "sunshade" should stop about 18 in. up from the main platform so that an explosive mixture of gasoline vapor and air cannot accumulate under it. A 2½-in. space is to be allowed between the outer "sunshade" and the inside lagging. To enable the entire contents of the tank to be withdrawn a well is to be welded to the bottom into which the suction pipe will dip.

Some of the more important details recommended by the committee for the construction of cattle cars may be briefly summarized. Wooden floors are to be provided with drain holes, "blinded" below so that the contents cannot be pilfered should the wagons be used for the conveyance of goods, such as grain. The hinged doors are also of wood and cattle guards are to be fitted in the door openings. Ventilators are omitted.

Suggestions for improvements of the standard types of cars have been invited from business men and users generally to supplement the work of the committee. Of the suggestions made the following may be mentioned: No leather to be used for joints and valves, all joints, etc., are to be metal to metal; the filling pipe for tank cars to be extended down to within 4 in. of the tank bottom so as to avoid splashing, which may give rise to the formation of gas while the filling is in progress; the well welded to the tank bottom to be at least 6 in. deep and placed in the center of the car; the filling pipes to be fitted with a cone screwed joint in place of a flanged joint; the dipping hole to be in 2 in. diameter. Oil companies have decided to provide their own float arrangements for determining when the tank is loaded as authorized.

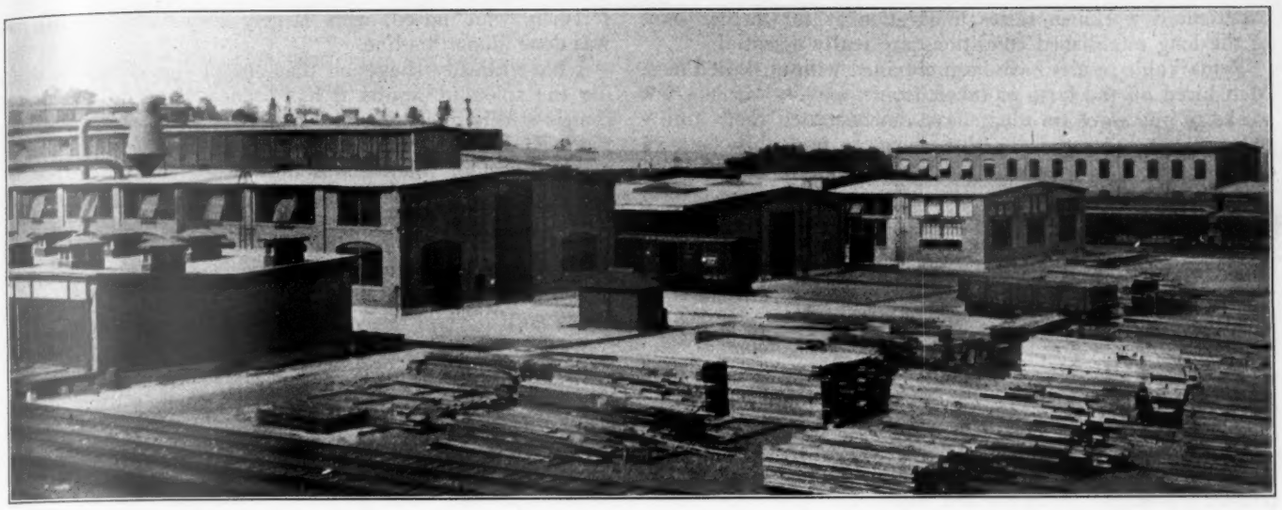
It was stated that the tank cars for the 5 ft. 6 in. gage were to be four-wheeled, while those for the meter gage were to have trucks, the reason being that it enables the cubical contents of the two types to be the same. Thus, a load could be transferred easily from a broad gage to a narrow gage, or vice versa. Oil shippers are practically unanimous in preferring welded tanks to riveted tanks. They have therefore been recommended for both gages. It is a common experience that in the case of accidents resulting in damage to rolling stock they may remain tight, whereas riveted tanks are liable to leak.

As regards vans for the conveyance of explosives, the following points were recommended for consideration: They must be kept as cool as possible; the possibility of concussion must be reduced to a minimum; shifting of loads to be avoided as far as possible. To carry out these suggestions the wagons are to be provided with wooden casing boards round the sides, ends and roofs, with a space of 2½ in. between these casing boards and the outer sheets, which is to be filled with slag wool to reduce the temperature. The outside of the vehicle is to be painted white. To reduce concussion the floor will be made of soft wood, 2½ in. thick, carefully planed and firmly secured to the underframe by means of countersunk head bolts, to be sunk 1 in. into the planks, the bolt holes being plugged up with wood or suitable substitute.

The above is a brief summary of the salient points of the report of the Standard Wagon Revision Sub-Committee. It started its work in Calcutta during September, 1921, and finished in May, 1922. The time devoted to the report was considerably longer than that of the previous 1919 committee which found three months sufficient for its duties. The work of these committees was rendered extremely difficult owing to the conflicting requirements of the mechanical and traffic staffs of the different railways. The committee has endeavored to embody the best features of modern design into vehicles which will serve as recommended standards of their respective types. The feature which the committee most desires to emphasize is that renewable parts, such as axle boxes, drawbars, buffers, wheels, brake shoes, etc., must always be interchangeable and, therefore, standard.

No attempt has been made to provide friction draftgear on either the 5 ft. 6 in., or the meter gage vehicles, but there is no doubt that approved forms of this might be adopted with advantage provided they interchange with standard details and fit in with the fixed dimensions laid down. The eye end of the drawbar lends itself to the easy attachment of such a device. The coil springs for drawbars are interchangeable with those used in the buffers.

As the distances between the chief railway centers and depots in India are considerable and the means of rapid transport are limited, it is important that the principle of standardization should be adhered to not only in leading dimensions, but in general details and especially as regards those fittings known as "renewable."



What Car Foremen Owe Their Industry*

Foremen Must Lead and Train Their Men—Business Management of Repairs as Important as Technical Knowledge

By C. B. Peck
Associate Editor, Railway Mechanical Engineer

THE five years which have elapsed since the inauguration of federal control of the railroads constitute the most trying period in the history of American railroads for the men charged with the responsibility of operating and maintaining the properties. No group of these men has been more severely tried than the foremen in the mechanical department. During federal control they saw the morale of the men under their supervision seriously impaired, if not completely destroyed; they were forced to assume a constantly increasing responsibility at the same time that practically all authority in matters of discipline was taken from them.

Then came the drastic retrenchment of 1921 which further disrupted car and locomotive maintenance organizations and, along with the extensive home movement of freight cars, caused a tremendous accumulation of cars held out of service for heavy repairs. The full effect of the improved business conditions in 1922 had hardly been felt before the officers and foremen of the mechanical department were again face to face with a crisis brought about by the shopmen's strike. Men who have passed through such a series of events and can still smile, who will not admit that the railroad business is not the greatest industry in the country, have certainly been tried and not been found wanting.

For the first time in the history of American railroads the weekly car loadings of revenue freight exceeded the million mark during the fall of 1920. The movement of such a volume of traffic was at that time hailed as a great accomplishment. But over a million cars of revenue freight were loaded during two successive weeks last fall, and from the end of the bituminous coal strike late in August until the end of last year, the total volume of freight loaded was practically the same as that for the similar period of the previous record year, 1920. You men know how much the car foreman had to do with the accomplishment of that result and in the face of what odds he had to work. You have a right to feel a large measure of pride in the result. No mark of appreciation which the managements can show can be too great for the high type of loyalty which made this possible.

But with the ending of the strike, which I believe marks the end of our worst troubles in the mechanical department, we can well afford to look back over these years of nightmare to see if they may not suggest something helpful for the future. It is quite evident that on many roads conditions in the shops and on the repair tracks are considerably different than they were before the strike. Whether or not the changes prove to be of permanent benefit depends largely on how well we get the lessons of these last few years and the extent to which we put them into practice.

All systematically organized operations tend to become so standardized that their performance ultimately grows to be largely a matter of routine. When the routine has once been developed, its constant repetition gradually wears such deep grooves in men's habits of thought and action, that it becomes extremely inflexible. The conditions of the National Agreement marked the ultimate result of our habits of thinking with respect to the requirements for the performance of the various jobs involved in the maintenance of equipment. The kinds of work to be performed by members of the various crafts became so minutely defined and the conditions surrounding their performance so narrowly fixed that reasonable efficiency was impossible and it seemed almost as though the rules had become the main object of the game.

Inexperienced Men Do Good Work When Trained

When emergency conditions arise the grooves of routine disappear. During the shopmen's strike every officer and foreman on the job had to give constant thought to what he was going to do and how he was going to do it. The effectiveness with which the railroads continued to function throughout the strike is all the evidence needed to prove that every man charged with any responsibility was able to visualize the immediate end that had to be attained and to plan a course which would reach that end with no waste effort. But the way equipment repairs were made with comparatively in-

*A paper presented before the Car Foremen's Association of St. Louis, March 6, 1923.

experienced workmen raises a question as to whether some of the long established conditions are really essential.

Remarkable results have been obtained with unskilled men. Men hired off the farm or taken from the office, after a few weeks of intensive training, have demonstrated their ability to turn out car repairs which compare favorably both in quality and quantity with the work turned out by what we considered our trained men prior to the strike. There are several factors which account for this result. The first is the fresh interest with which men approached their tasks. They were subjected to no insidious suggestions that they curb a natural desire to develop skill and facility in the performance of their tasks. The second is the intensive training which these new men received at the hands of the foreman. The third is specialization. No one could expect these men to acquire the skill of all-round mechanics in the short time which served to develop them into fairly effective workers. They did demonstrate the ability to become proficient in a specialized job, however, with a very small amount of intensive training.

Apprenticeship

One of the conditions inherited by the railroads of the present day is the apprenticeship system as we have long known it, in which boys who have not yet reached complete maturity are indentured for all-round training in the work of a particular craft. Where properly conducted, with a far-sighted regard to the future relations between the boy and the company he works for, not only has this system left little to be desired as to the development of skilled workmen, but has laid the foundation for future supervisors. There was a time when apprenticeship on the railroad and in those industries requiring the performance of similar kinds of work were much the same. For at least 10 years, however, there has been taking place a marked change in some of the industries. Highly specialized production methods have been constantly narrowing the field for the all-round mechanic and extending the field for the specialist, who can command good wages after a comparatively short period of training. This condition, which is most highly developed in the automobile industry, has become general enough in many communities so that its effect has been felt by the railroads. At any rate, we are all more or less familiar with the fact that there has been a gradual change in the character of applicants for jobs as railroad apprentices in that length of time.

Not many years ago the railroads placed considerable stress on giving prior consideration to the applications of sons of employees for apprenticeship and applications from boys within the railroad family, so to speak, were sufficiently numerous so that this provision actually played a part in the selection of apprentices. Not only has it now become practically a dead letter, but it has been necessary to increase the age limit of applicants for regular apprenticeship, and this having failed to keep up the supply, to go further and give the helper a chance.

If experience during the strike is any criterion it is evident that forces for the maintenance of equipment can be kept up even though the former type of apprenticeship were gradually to disappear. Even though it may never meet all the requirements of the mechanical departments of the railroads, specialized training has sufficiently demonstrated its success in an emergency to make it a real factor for consideration in the future and we are justified in looking with more respect on the capacity of the humble helper to develop into a future skilled worker than we have generally done.

It must be clearly kept in mind, however, that whatever the source from which skilled workmen are drawn and by whatever name the system of developing them is called, it requires education and training, and for this the railroads must take the responsibility. One of the reasons for the success in the rapid development of unskilled men during the strike was the keen personal interest in training them taken by the foremen, who indeed, were largely responsible for all that was done along this line.

I have already suggested that one of the factors in securing the splendid results it has been possible to attain with comparatively inexperienced men was the natural and unhindered interest which they took in their jobs. The lack of this kind of interest was one of the leading causes for many of the mechanical department ills during the past five years. Indeed, this was so pronounced that some railroad officers have come to feel that their men were entirely devoid of a sense of honor—that they possessed so few of the common virtues of human nature as to belong to a different class of beings from the rest of mankind.

Attitude Toward the Job

However, the employees themselves are not entirely to blame for the growth of the attitude which they have been taking toward the railroads and the jobs they were paid to perform. There are several causes which have led to the development of this attitude. One of these is the old idea, now pretty much outgrown, that the employer owes nothing to his employee beyond the amount of his pay check and that it is the duty of every man in a supervisory position to oppose as a matter of principle, any improvement in conditions or pay sought by the employee. The development of a fighting spirit which in time grew extremely bitter, is the natural outcome of this complete opposition at every point in the consideration of questions each of which ought to have been settled in fairness on its own merits. This kind of opposition, once in existence, made a fertile field for the activities of bad leadership, which, with a background of bitter feeling has not found it difficult to make conduct which the men would otherwise recognize as dishonest, seem to be justified.

There is a natural human tendency in all men toward the establishment of satisfactory personal relationships in all the affairs of life. Now, there is nothing personal in the relationship between the employee and a corporation, as such, and as a practical matter the personal nature of the relationship between the employee and the head of a department must be very limited. The whole matter of a satisfactory personal relationship, or indeed of any personal relationship at all, then, comes right back to the foreman. Foremanship implies leadership to a far greater extent than is measured by the assignment and checking up on the performance of tasks. One of the greatest responsibilities of the foreman to his company and to the railroad business as a whole is that of assuming a personal leadership over his men in all matters affecting their attitude toward the company they work for and the welfare of industry as a whole.

Fortunately the attitude of hostility and the restrictive conditions of the National Agreement have been overdeveloped to such an extent that they have carried their own antidote. The relief with which the men on many roads view the clearing of the air and the willingness, even eagerness, with which they accept conditions which are less arbitrarily restrictive, both to the railroad and to their own personal opportunities, has been apparent for several months. This spirit offers the opportunity for the establishment of more natural and far more satisfactory personal relationships. It needs to be carefully fostered. It will not maintain itself unless the managements and particularly the foremen take the utmost pains to meet the men half-way in a spirit of fairness on all questions which may in the future arise between them, whether they be questions of wages, of working conditions, of the assignment of men to jobs, or promotion.

Let no one think that he can with impunity restore the old fashioned despotic control. Men who work for a living have learned how to organize to deal with what they consider to be unfair conditions or unfair treatment and there are plenty of demagogues waiting to seize upon the faults of those who have the job of running the railroads, and use them to develop a class hatred against all employers, which in the

end, if they can accomplish their purpose, will destroy the prosperity of everybody in the country.

How can such a result be avoided? In the first place let me say that I have absolutely no scheme of organization to suggest for handling matters which necessarily will always come up for adjustment between managements and men. Undoubtedly some machinery is necessary. But the poorest organized machine, well lubricated, will continue to run long after the most skilfully designed machine, operated without lubrication, has been thrown on the scrap heap. The important thing, then, in fostering the new spirit of co-operation which is growing among employees in the mechanical department, is the maintenance of an attitude of the most scrupulous fairness on every question that has to be considered. This is the lubricant that will make the simplest method of organization function with success and mutual satisfaction. But the least suspicion of sharp practice will act as sand in the bearings to destroy satisfactory relations no matter how carefully every contingency may have been anticipated by the provisions of an elaborate agreement.

Does not every foreman owe it as much to his industry to use every resource at his command to keep up this spirit of fairness and co-operation, the absence of which eventually will destroy the business, as he does to be proficient in the rules of interchange or to organize his gangs and assign his work effectively? Ought he not to give as much thought to the exercise of his function as a leader of men as he does to the performance of his duties as a boss?

Foremen Control Large Expenditures

In 1920 car foremen supervised the expenditure of $714,000,000 to maintain passenger and freight cars on the Class 1 railroads. This amounts to over $3,000 for every mile of road and is over $100,000,000 greater than the amount spent in the maintenance of locomotives. In addition to their responsibility for the effective use of this vast sum they are responsible in a high degree for the safety of train operation as well as for one of the most important phases of inter railroad business,—car interchange. These duties all require a high degree of technical knowledge, the nature and importance of which it is unnecessary to deal with before you men. What I do wish to dwell on for a few moments, however, is the danger of giving too much attention to the technical side of the foreman's duties to the exclusion of any attention at all to the business aspect of spending the vast sum required to keep the rolling stock in operation.

The title of my remarks suggests that the foreman has certain obligations to the industry. Before he can be held to any business responsibility, however, the head of the department and the management in general must place more stress on the business of car maintenance than on its highly specialized technical aspects, and it owes it to the foreman to train him and give him every assistance possible so that he may develop judgment in the management of his operations on a business basis.

Methods of Departmental Management

There are two opposing ideas as to departmental management. One assumes the creation of a super-boss who delegates as little authority to the supervisors directly on the ground as possible; who takes the credit for success and blames his subordinates for failure; who gives his subordinates as little information as possible and issues arbitrary orders without explanation. The other idea assumes that the office of the head of the department is a service bureau from which each subordinate has a right to expect real assistance in the way of information showing clearly how his operations tie into the performance of the department as a whole, as well as assistance in organizing to meet any unusual conditions which may arise.

There is at least one car department in which this idea has been carried out to the extent that each foreman in charge of a car repair point has become practically a business manager over his operations. He is controlled by a budget system, but within his appropriation he has the authority to take his own measures and must assume the responsibility for the result. Each month he must render a report of his operations and after all these reports have been compiled and digested at the general office he gets a copy of the combined report which gives him the same picture of the operation of the department as a whole that the management has.

Many car foremen operate at outlying points where they have little opportunity to come directly in contact with the head of the department and ordinarily find it difficult to keep closely in touch with what is going on elsewhere. To attain the highest possible success, these men must be encouraged to develop initiative and must be given authority to settle on the ground every possible local question arising between their own department and other departments, without the necessity of referring it to a distant headquarters. Will not efforts spent in furnishing these men all the information possible as to the relation of their work to the railroad as a whole and in guiding them in the development of sound judgment and initiative be far more valuable to the railroad than all the efforts which possibly can be put forth to run their job for them from the general office?

The type of initiative of which I have been speaking does not imply any lack of control either of the extent of the operations or of standards of maintenance. It means an informed body of men who can carry out general instructions as to standards intelligently because they know the reason why those instructions are necessary.

Cars Must Be Available

The real business object of the car department is to keep cars available for service the largest possible percentage of the time. Since September 1, there has been a continuous net car shortage which reached its largest proportions late in October. It is evident that during a time of car shortage every car that must be held out of service for repairs represents a direct loss of revenue to the railroads, which amounts on the average to somewhere in the neighborhood of $200 a month. And if, in order to overcome an unnecessarily high percentage of bad order cars, the railroads buy more cars than they would otherwise require, they are obliged to pay the carrying charges on an investment of from $1,700 to $3,000 for every such car purchased. Furthermore, it is well to keep in mind the fact that the interest and depreciation on this investment keep on piling up during the period when there are normally more cars than the railroads can use as well as during the time when every car is required for traffic.

The railroads have made a good showing in the last few months in reducing the number of cars held out of service awaiting heavy repairs. There is, of course, some question as to what extent this reduction has been affected by returning them to service with the smallest amount of patch work possible, and how much it is due to constructive work which will keep the cars in service for the next four or five years with only occasional attention for running repairs. For the country as a whole bad order had been reduced from about 13 per cent at the end of September to 9.2 per cent at the beginning of February. The latter figure, however, in a period of car shortage, is sufficient to indicate that there is a long pull ahead of the car departments before conditions can be considered satisfactory.

With the present pressing demand for cars every car department officer is faced with a most difficult problem of making every man hour and every cent expended in car repairs give the maximum return in days of revenue service. Patchwork will not accomplish this result. It is only deferring the day of reckoning from the present shortage until the next, since little may be expected in the way of improvement during the intermediate period of slack business, and is shifting the responsibility from one repair track to another.

It would be useless for me to attempt to tell you how that problem is going to be solved under present conditions. Indeed, the maximum return in days available for service for every dollar of maintenance expenditure can not be attained by any emergency measures, but only on the basis of a well developed policy, which, when once established, is consistently adhered to year in and year out.

Program for Maintenance

Generally speaking, there has been little in the way of consistent policies with respect to freight car maintenance. A few railroads, however, have attempted to develop a systematic freight car maintenance program similar to that generally adhered to in the repair of locomotives. Instead of permitting freight cars to run until they are returned home in such condition that they are fit for no further service, years after they should have been overhauled, a definite period of, say, 7 to 11 years is established, depending upon the type of construction and character of service the car is designed to perform, after which the car is shopped.

It will be generally admitted that such a plan will save many trips to repair tracks for jobs of a patchwork nature from which no adequate service return is obtained. It is also reasonable to expect that a carefully considered program of this kind will put the roads in a position to provide more serviceable cars when they are most needed, with less frequent resort to emergency measures and, therefore, with the least upsetting of the planned operations of the department. This is merely applying the principles of scheduling and dispatching which have met with such success in reducing lost motion and waste in shop operation, to the operations of the department as a whole. Is it not reasonable to expect from it the same benefits in this broader field that have actually been obtained in the narrower and more specialized field of shop operation?

Transportation Vital

There is one other obligation which the foreman owes to his industry that I would like to suggest. There is no greater industry than that in which we are all directly or indirectly engaged. The foundation of our whole material civilization is transportation. Without it we would all have to go back to scratching our own living out of the ground, with the aid of the most primitive implements. We would have to produce our own textile goods on the spinning wheel and hand loom. In fact, each family would have to become a self-supporting unit, and for many of us I am afraid that would mean an increase of many hours in the day's work.

Twenty-five years ago Harriman spent $25,000,000 in about three years in rebuilding and re-equipping the run-down Union Pacific. In doing so he made a fortune for himself through the increase in the value of his holdings in Union Pacific stock. Why? Because the territory served by that railroad was awaiting the opportunity to develop and it did develop just as rapidly as the increasing capacity of the railroad to haul out the products of the soil and haul in the needed manufactured goods, would permit. Harriman's own estimate was that he saved the territory served by the Union Pacific at least 10 years of waiting.

This gives some idea of what the expansion of railroad facilities means to the expansion of the other industries upon the success or failure of which the prosperity of the country depends. Without the constant expansion of railroad capacity a continuous increase in the volume of commodities produced in this country is impossible.

There is a well organized effort, both in and out of Congress, to destroy the railroads as privately owned and operated property, in order that a situation may be created in which government will be forced to take them over.

I do not come here to discuss with you the relative merits of private ownership and government ownership of the railroads. Some of you men may believe that the interests of the public and the employees would be best served if the railroads were owned and operated by the government. I have no quarrel with any such sincere belief. I do want to call attention to one thing, however, and that is that to bring about a state of government ownership through the process of destroying the property of the railroads and their earning capacity merely because they are privately owned, serves neither the interests of the employees nor the public.

Whatever his opinion may be as to the correct ultimate solution of the railroad problem, no man who gets his living from the transportation business can afford to jeopardize his own interests by furthering, either actively or passively, the campaign of misrepresentation by which it is hoped to bring about the repeal of the Transportation Act and the passage of legislation by which the government can first destroy the value of the properties by removing their earning power and then can buy them from their owners at the depreciated value created by this vandalism.

Interests of Roads and Employees Common

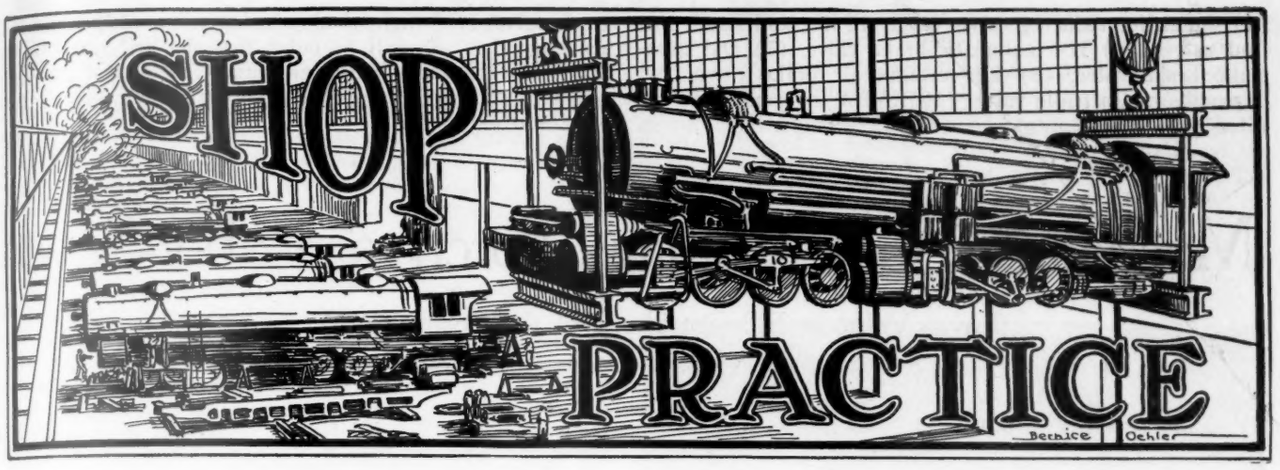
In an address before the February meeting of the Western Railway Club, W. G. Lee, president of the Brotherhood of Railroad Trainmen, clearly showed where the interest of the employees lies in this matter. He put it this way.

"The public has been diverted in the past few years by public statements made by railroad companies and their employees. The roads have said that transportation employees were extravagantly paid, that they had the easiest positions and the highest pay of any employees in the country, and that further concessions granted them simply meant robbing the public pocketbook, which, in this instance the railroad companies were quite prepared to protect. The railroad employees have countered by setting forth that the railway companies were extravagantly operated, that because of watered stocks, dishonest management and inefficient operation they were, in many instances, not showing the revenues they should, and insisting that if they were given honest management, there would be no difficulty in meeting the wage demands of their employees. Whether we agree on all subjects that come between us or not, we must agree that in the public estimation the railroad companies and their employees are not separated. The public accepts both statements as gospel truth and exacts its toll of transportation service at its own price against both of them.

"Let us satisfy the public that the railway companies and their employees are not what they have called each other, but that they are exactly the contrary; that they are serving the transportation needs of this country in a more efficient manner than they are being served in any other country in the world; that the railroad companies are efficiently managed; that their employees are giving efficient service, and that both of them are worthy of their hire."

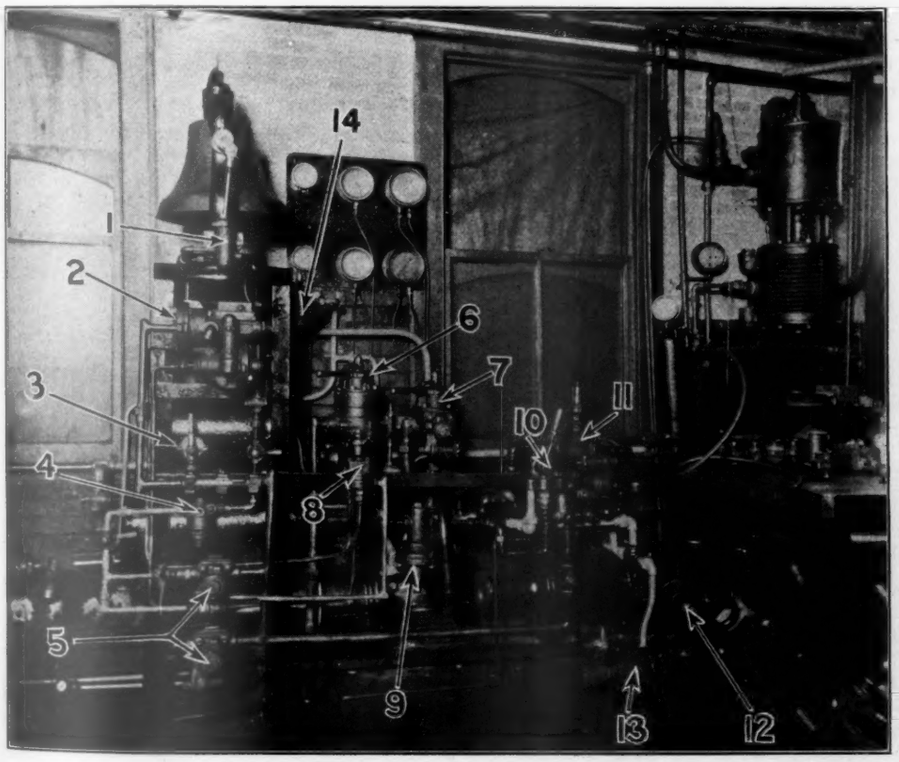
If we are going to have government ownership let us get it in an orderly manner. Let us not subject ourselves to the necessity of spending long years of our lives engaged in a bankrupt business with all the hardship that it will entail on the employees particularly and on the public in general.

In this matter is one of the most important duties that the foreman owes to the business in which he is engaged. If he has assumed the position of leadership among the men for whose work he is responsible, who is in a better position to keep them thinking straight on this all-important question, and who is in a better position to speak for the industry in his community? But if the foreman is to fulfill this duty which he owes to the business in which he is engaged, he has a right to be informed as to what the facts are with respect to it. Here is an opportunity and a duty for the management, which it ought not to let pass. The more every man in the business knows about the problems of the management and how they are being met, the more loyal he is likely to be to the company by which he is employed and in that loyalty the management has a real weapon with which to meet some of the attacks of misrepresentation to which it is subjected.



Compact Air Brake Test Rack in Enginehouse

ONE of the important functions of an enginehouse is to keep the air brake equipment on locomotives and tenders in the best possible operating condition. The air brake test rack shown in the illustration assists in attaining this end at the Hoboken enginehouse of the Delaware, Lackawanna & Western. This test rack was constructed recently by local enginehouse men under the direction of M. R. Feeley, general enginehouse foreman.



A Compact Air Brake Test Rack Recently Installed at the Hoboken Enginehouse of the D., L. & W.

Before considering a description of the test rack, its advantages may be pointed out. It frequently saves a considerable amount of time in getting locomotives with defective brake equipment back into service; it speeds up the repair of all parts of the air brake equipment. By having one or more of each kind of valve repaired in advance, when a locomotive comes in with a defective brake valve for example, the valve is removed and another which has been recently tested is applied without loss of time. This prevents holding the locomotive out of service while repairing the defective brake valve.

Another important point is that the repaired brake valve has been tested and is known to be correct. If for any reason, therefore, the brakes do not work the trouble can be looked for elsewhere than in the brake valve. This test rack makes the enginehouse self-sustaining as far as air brake repairs are concerned except for the air compressors. The actual work of repairing air brake valves is facilitated by means of this test rack because the valves can be applied to the rack, defective parts being quickly indicated to experienced repairmen by the readings of the gages.

In general, this brake test rack is a duplication in compact form of the air brake equipment on a locomotive and tender. The air compressor is driven by air from the shop line at 100 lb. The lower air cylinder is bushed and in addition has 100 lb. air pressure piped to the inlet. This enables the compressor at a few strokes to develop pressure up to 140 lb., at which the governor is set. A gage and governor is applied as in the actual installation of a locomotive. The location of the various valves is indicated plainly in the illustration and from left to right near the floor can be seen the engine brake cylinder, tender brake cylinder and auxiliary reservoir under the bench. Extra capacity in the train line to compensate for the train line capacity in actual service has been obtained by means of additional reservoirs and manifolds.

In addition to parts of the air brake equipment, arrangement has been made to test the bell ringer and sand valve. The following is a list of valves and parts which can be tested on this test rack, the numbers giving the location: (1) bell ringer, (2) distributing valve, (3) sander valve,

(4) signal line reducing valve, (5) train line and signal line feed valves, (6) H-6 automatic brake valve, (7) D-5 automatic brake valve, (8) ET straight air brake valve, (9) locomotive plain triple valve, (10) S-3-A independent brake valve, (11) air compressor governor, (12) tender quick action triple valve, (13) high speed reducing valve, (14) signal line whistle valve. It will be noted that the bell ringer is attached to an actual bell from which the clapper has been removed and thus the device is given a test under actual working conditions.

Mechanical Gas Cutting Torch a Labor-Saver

Proves Value at Billerica Shops of the Boston & Maine— Wide Variety of Possible Uses

IT would be easier to mention the locomotive and car repair parts which cannot be shaped with the mechanical oxyacetylene cutting torch rather than those which can. The mechanical torch illustrated is installed in the Boston & Maine repair shops, North Billerica, Mass., and represents a type of equipment which has already accomplished important economies in several shops throughout the country.

Parts Profiled With Mechanical Torch

Name of Part	Time
Large side rod (complete)	65 min.
Solid main rod (inside and out)	80 min.
Frame section (dependent on size)	120 min.
Radius rod (long fork end)	15 min.
Union link (fork ends)	5 min.
Walschaert link	45 min.
Drawbar (including holes)	30 min.
Guide yoke (complete)	22 min.
Guide (allover)	25 min.
Main rod straps (inside and out)	35 min.
Four bar crossheads	28 min.
Brake fulcrums, levers, etc.	.....

The accompanying table shows some of the parts profiled on this machine together with the approximate time required for each operation.

The character of the work turned out on this machine is excellent and the amount of time and labor saved in the representative operations listed will be appreciated by anyone familiar with locomotive shop work. Heavy forging operations on some parts are entirely eliminated and on others greatly reduced. The time and cost of machine operations are also lessened and in certain cases subsequent machining can be foregone entirely, saving the entire cost of this operation. Parts made of high-carbon steel, however, are subject to surface checks due to unequal expansion and contraction as the torch passes over the surfaces. On parts of this character it has been found best to take a light finishing machine cut after blocking out with the mechanical torch. This practice, of course, involves setting up the work for machining, but far less time is required because most of the stock has been blocked out with the torch. Low carbon hammered steel as a rule does not check, eliminating difficulty from this source.

Description of Equipment

Referring to Fig. 1, the construction and use of this mechanical oxyacetylene cutting torch will be readily apparent. The laying-out table *A* and the billet to be cut, *B*, are both supported on a channel iron frame work bolted to cast-iron box legs. (Cast-iron is used as the cross members will not be so readily cut when the torch passes over them). The movable arms of the device are supported on two uprights *CC*, the arm arrangement forming a pantograph so that any motion given to tracing wheel *W* will be imparted, both as to direction and amount, to torch *T*. A small electric motor *M* is geared to drive the tracing wheel *W*, imparting a positive

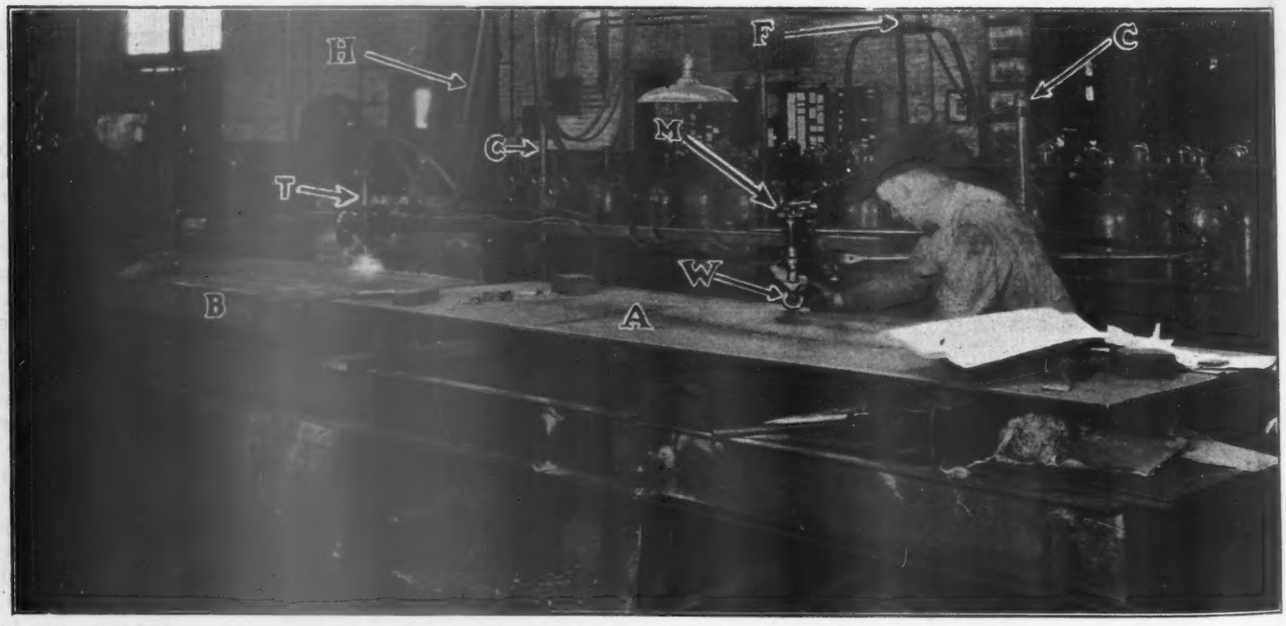


Fig. 1—Mechanical Oxyacetylene Cutting Torch Equipment Profiling a Large Front Frame Section from a 5-in. Billet

steady movement to the wheel support and consequently to the cutting torch.

The cutting torch *T* is provided with the ordinary adjustments and tips for controlling the flame to suit various kinds and thicknesses of metal. Two lengths of hose *H* supply oxygen and acetylene to the torch and this hose is supported in the loops shown from an overhead radial arm, the base of which is shown at *F*. This arrangement permits easy movement of the hose to suit the movement of the torch. Three lines are apparent at *H* and one of these is the electric wire extension which appears wound around the horizontal arm and transmits electric current to the motor *M*.

In using this machine, the part to be formed is laid out on table *A* and one operator starts motor *M* guiding the tracing wheel over the outline. Sometimes a straight edge is used to assist him in following the straight line exactly. Templates are used for standard shapes and parts. Odd shapes are simply chalked on the layout table.

The second operator adjusts the cutting torch and watches it constantly to keep it at just the right adjustment. Whatever shape is traced by wheel *W* will be cut by torch *T*. Before starting a cut on a big billet, as illustrated, it has been

Fig. 2—View from Another Angle Showing Method of Supporting Billet

found best to run over the outline first with the torch, preheating the billet and breaking up any scale or oxides on the surface. A smoother job is thereby obtained.

This machine has a capacity to cut metal up to 14 in. thick by 12 ft. long. Straight lines, circles and irregular lines be cut with equal ease. By means of a special extension arm arrangement large circles for boiler work can be cut.

Accuracy and Smooth Finish Secured

The accuracy and finish secured by this power-driven cutting torch is far superior to anything that can be obtained by hand. It is well known that with a hand-operated torch the effects of breathing and even heart action are reflected on the work, but such irregularities are eliminated by the constant speed motor drive of this machine. On many parts the finish is such that machining is not necessary.

The billet, illustrated in Fig. 1, is being cut into a large front frame section, the billet being 5 in. thick and the frame section 34 in. wide by 10 ft. long. Fig. 2 gives a better view of the billet, showing the method of supporting it on the channel irons and with a chain fall. A heavy cut is being taken along the outer edge.

Referring to Fig. 3, some of the work performed on this machine is indicated as follows: (A) guide yokes, (B) engine truck equalizers, (C) safety drawbars, (D) radius rods, and a pile of union links in the background. The radius rods, it will be noted, are forged out in accordance with the usual practice and the long fork ends cut out with the mechanical torch. The same method is used with the union links. The equalizers are offset by forging and the ends cut to the standard shape and size with the torch. The safety drawbars are outlined and have the two holes cut with the torch, requiring no machining.

A careful check is kept on costs with this machine at Billerica shops to make sure that parts are not cut out

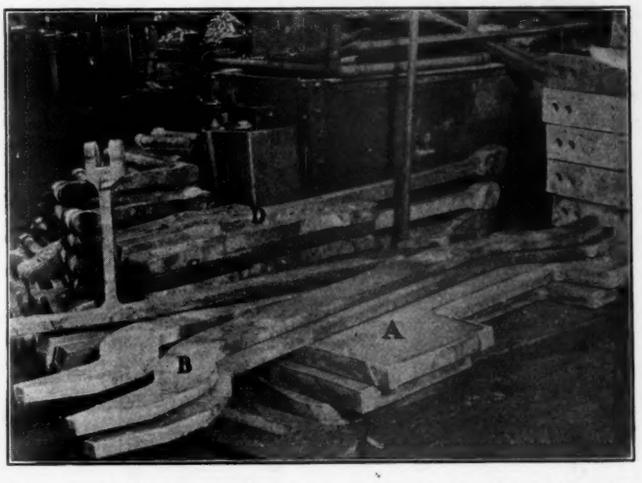


Fig. 3—Familiar Locomotive Parts Profiled with Mechanical Gas Cutting Torch

which can be more cheaply bought, but the demand for work already exceeds the capacity of one machine and it is said that another could be profitably employed. The possibilities of mechanical gas cutting equipment in railroad shops is almost limitless.

Testing Hose Nipples and Couplings Before Mounting

By T. H. Birch

Air Brake Foreman, Chicago, Milwaukee & St. Paul, Milwaukee, Wis.

IT has been our experience that many hose nipples develop porosity and sand holes, a condition which has been almost impossible to detect until the nipples have been mounted in the hose. This is especially true with respect to steam hose nipples and it therefore frequently becomes necessary to dismantle hose after the nipples have been mounted. The same condition has been experienced in the use of second-hand air hose couplings. The only guide to the condition of these couplings has been the A. R. A. gages and the inspection for such defects as were visible to the eye. It was, therefore, necessary to test all air hose after mounting, with the result that about 15 per cent of all hose mounted had to be worked over because of defects in the couplings which were not evident until the hose were tested.

To eliminate these two causes for duplication of work, the two devices here illustrated have been developed and installed in the air brake department of the Chicago, Milwaukee & St. Paul shops at West Milwaukee.

The drawing of the hose nipple testing device needs little explanation. A slack adjuster cylinder, mounted on a frame of ¾ in. by 7 in. material, provides the means for clamping the nipple in place, one end bearing against a rubber pad attached to the end of the piston and the other

against a similar pad mounted on a block on the bench to which the device is attached. The lower end of the nipple sets over the end of a pipe connection, through which air is admitted. In order that irregularities in the faces of the nipple may not interfere with properly sealing the ends, the upper seal is arranged to swing freely on the end of the piston. Two ⅜-in. stop cocks, the handles of which are connected with a link, control the supply of air to the slack adjuster cylinder and through necessary piping to the nipple pipe connection.

In using the device, the hose nipples are first dipped in a pail of soap suds and then tested while still wet. In this way sand holes and other porous places will be indicated immediately by the bubbles.

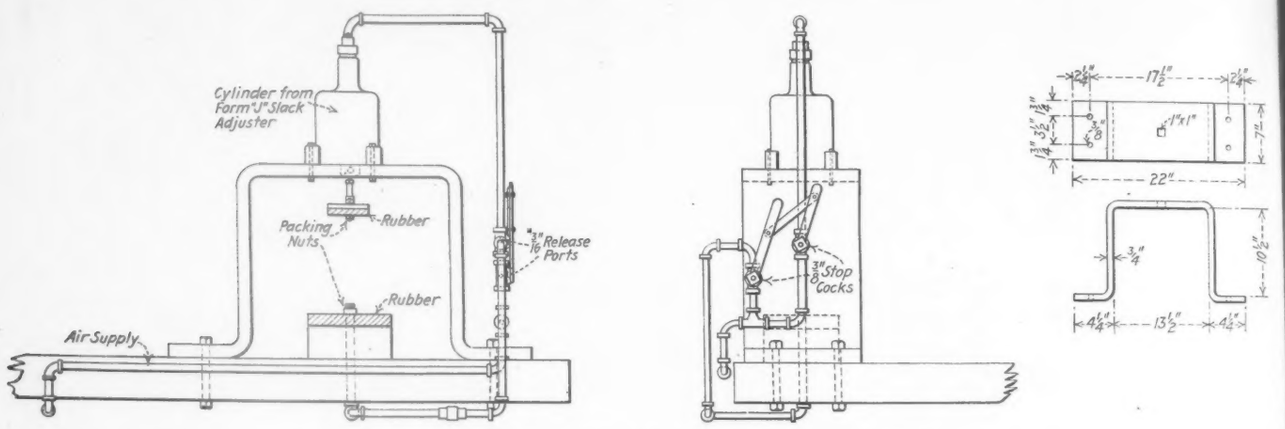


Fig. 1—Front and Side Views of Hose Nipple Testing Device

The brake hose coupling testing device is assembled on a base plate of ¾-in. material, 11 in. wide by 36 in. long. At one end of this plate is bolted an 8-in. brake cylinder and at the other end an angle bracket to hold the stationary half of the hose clamp. The movable half the clamp is attached to the end of the brake cylinder piston. A standard brake hose, connected to a ½-in. air supply pipe by a nipple and reducer, is located at right angles to the center line of the cylinder so that the open end comes between the clamp jaws. This end of the hose is reamed out so that the hose coupling can be readily inserted by hand. With the coupling in place a dummy coupling is attached and the three-way valve shown in the drawing is opened. This causes the piston to move outward, clamping the hose on the coupling just ahead of the enlarged portion of the coupling shank. At the same time, air pressure is admitted to the hose so that the coupling is subjected to a pressure test. With the aid of a brush and soap-suds, defective couplings are immediately detected.

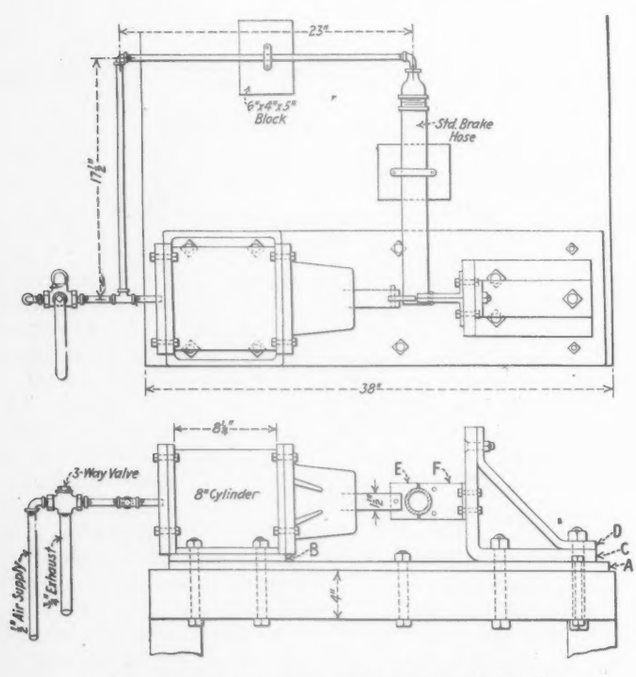


Fig. 2—Brake Hose Coupling Testing Device

As the hose wears, the end may be cut off and the hose moved forward by lengthening the nipple at the pipe connection end. In this way all but a few inches of the hose may be worn out before it becomes necessary to apply a new one.

In testing signal hose couplings, the standard brake hose is replaced with a signal hose and clamp jaws of suitable dimensions are substituted for the jaws which are shown in the drawing.

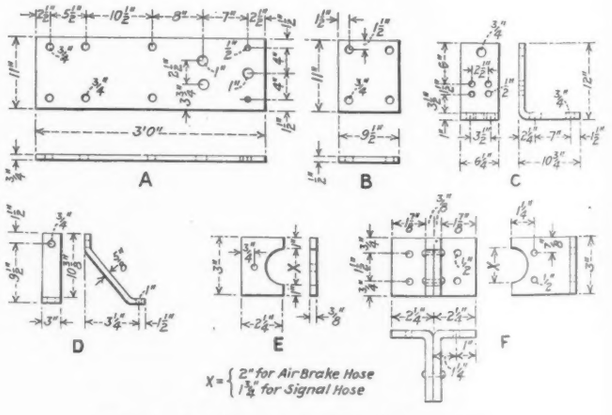


Fig. 3—Details of Coupling Testing Device

Since couplings have been tested in this device it has not been necessary to reject a single hose after mounting on account of defective couplings. The cost of making the test has been found to be one-half cent per coupling, including the cost of the necessary trucking. Not only has this practice saved a considerable duplication of work but it is also well to remember that some injury is done to the air hose tube if it is dismantled after once being assembled.

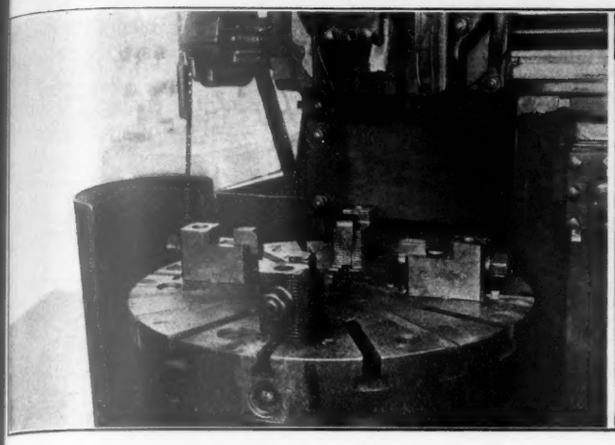


Fig. 1—Combination Chuck for Holding Packing Pot

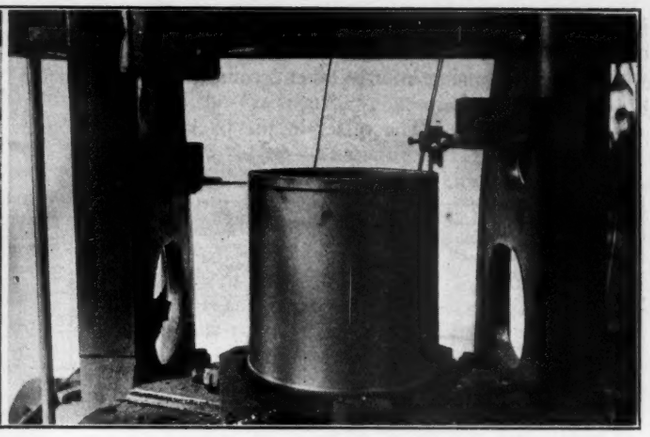


Fig. 3—Forming the Offset and Cutting Off a Ring

Machining Valve and Cylinder Packing

Outline of Machining Practice Followed at the Huntington Shops of the Chesapeake & Ohio

By E. A. Murray

Shop Superintendent, Chesapeake & Ohio, Huntington, W. Va.

SEVERAL articles descriptive of different methods of machining valve and cylinder packing have been printed recently, and since the methods of performing these important operations at Huntington shops are somewhat different from those previously described they will be of interest to

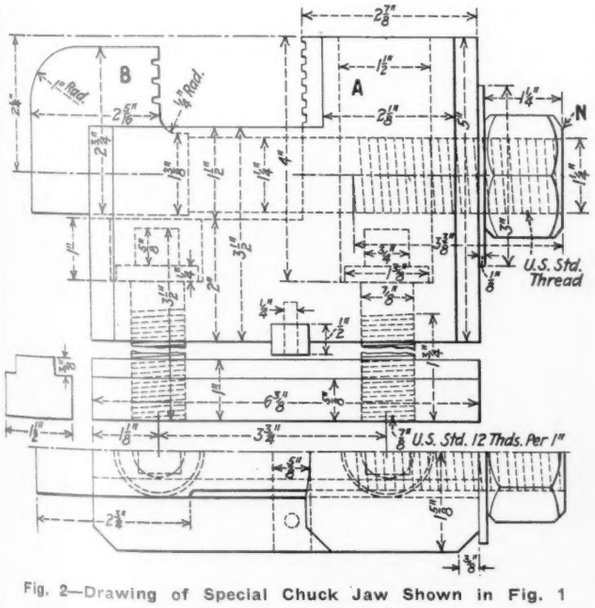


Fig. 2—Drawing of Special Chuck Jaw Shown in Fig. 1

at least a few of the many readers of the *Railway Mechanical Engineer*.

The following is the practice adhered to in machining valve packing rings:

First Operation—The packing pot is chucked in a combination boring mill chuck illustrated in Fig. 1. Owing to the design of this chuck, it is not necessary to have clamping lugs cast on the packing pot, and the pot can be used to within 1½ in. of the bottom. The chuck jaws bear on the inside as well as the outside of the casting, preventing it from slipping or being clamped out of shape. Greater cutting feeds and speeds can be used without danger of pulling the casting out of the chuck; there is a saving of materials; there is less danger of the last few rings being defective owing to excessive outside pressure of the chuck jaws.

A drawing of this special chuck is shown in Fig. 2, from which the simplicity of the design will be evident. The solid jaw *A* is held in the correct position on the chuck to suit different diameters by means of two square-headed ⅞-in. tap bolts which are threaded into the 6⅜-in. tee bar, the latter being an accurate fit in the body of the chuck. A ½-in. by ⅝-in. key holds jaw *A* positively against radial

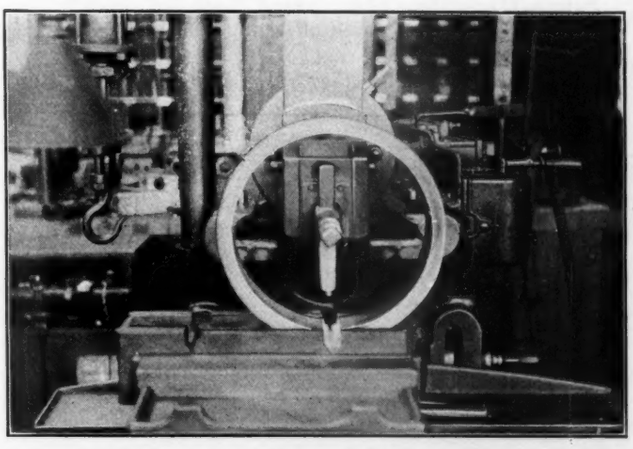


Fig. 4—Four Rings Are Held in a Special Shaper Chuck and Cut at One Time

movement except with the tee bar. Sliding jaw *B* is an accurate fit in a slot of the proper dimensions in jaw *A*, being tightened by means of the 1¼-in. nuts, gripping the casting on the inside and holding it far more firmly than is possible with ordinary methods.

Second Operation—The packing pot is machined on the

inside and outside, using both heads at the same time. The outside diameter is made 1/8 in. larger than the finished size, which allows the ring later to be cut, compressed, and turned to the finished size.

Third Operation—The offset in the packing ring is machined, as shown in Fig. 3, using a forming tool in the right tool post while the ring is being cut off with a cutting-off tool in the left tool post. The top of the ring is finished, allowance being made in cutting off for truing the ring on the plain side.

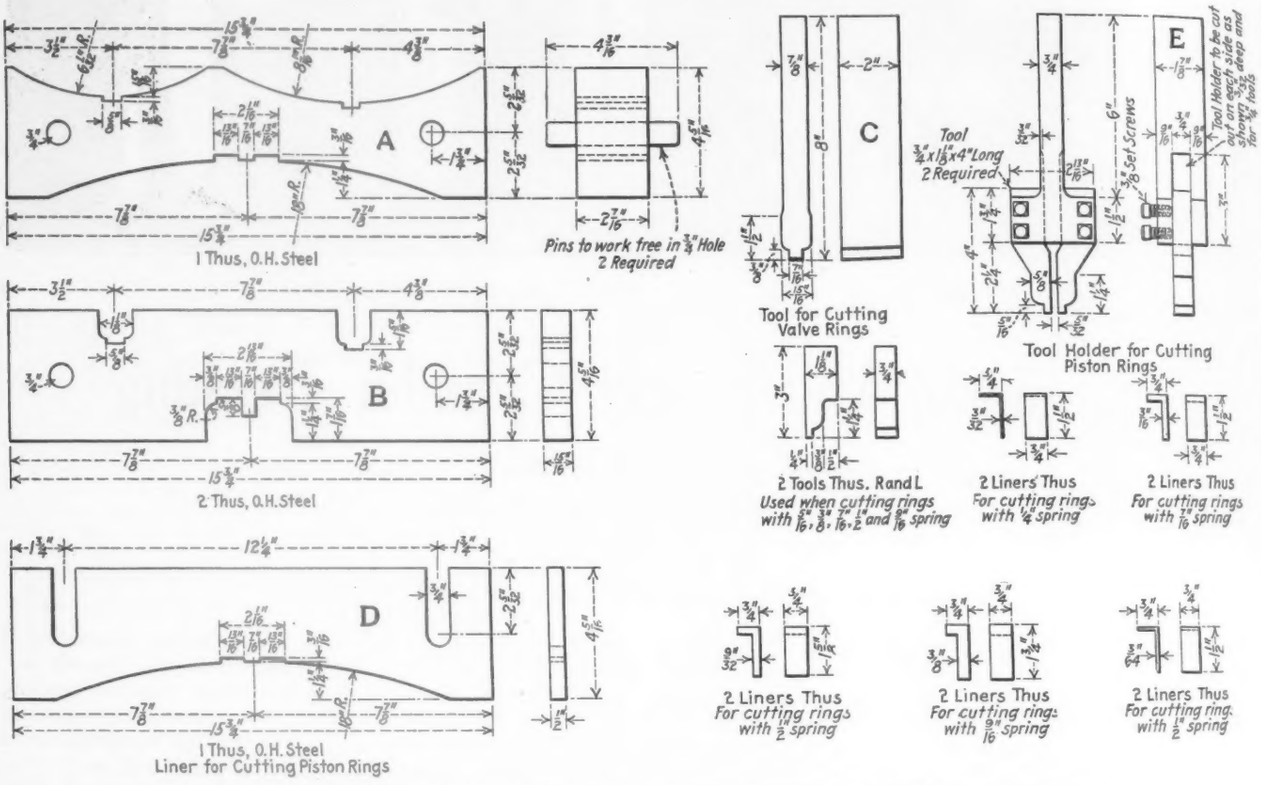

A
1 Thus, O.H. Steel
Pins to work free in 3/8" Hole
2 Required
B
2 Thus, O.H. Steel
C
Tool for Cutting Valve Rings
2 Tools Thus. R and L
Used when cutting rings with 1/16", 3/32", 7/64", 1/8" and 1/16" spring
Tool 3/4"x1 1/8"x4" Long 2 Required
3/8" Set Screws
Tool Holder to be cut out on each side as shown 3/32" deep and for 3/8" tools
E
Tool Holder for Cutting Piston Rings
2 Liners Thus For cutting rings with 1/4" spring
2 Liners Thus For cutting rings with 1/16" spring
D
1 Thus, O.H. Steel
Liner for Cutting Piston Rings
2 Liners Thus For cutting rings with 1/2" spring
2 Liners Thus For cutting rings with 9/64" spring
2 Liners Thus For cutting ring with 1/2" spring

Fig. 5—Details of Special Chuck and Tools for Cutting Valve and Cylinder Packing Rings

Fourth Operation—The packing rings are chucked individually in a lathe and faced off, using a snap gage to get the correct thickness.

Fifth Operation—The rings are placed in a special chuck on the shaping machine, four rings being cut at one chucking, as shown in Fig. 4. Details of this chuck and the cutting tools are given in Fig. 5. Referring to Fig. 5, *A* is the filler block which supports the packing rings, two end plates *B* holding the rings firmly when compressed between the chuck jaws in the shaper. Plates *B*, correctly alined with the filler block by two dowels, are cut away to allow special shaper tool *C* to cut the required slot in the rings. This slot is 7/16 in. wide and is the allowance made for spring. It will be noted that filling block *A* is provided with two radii 6 1/32 in. and 8 1/16 in. respectively to accommodate rings of different diameters.

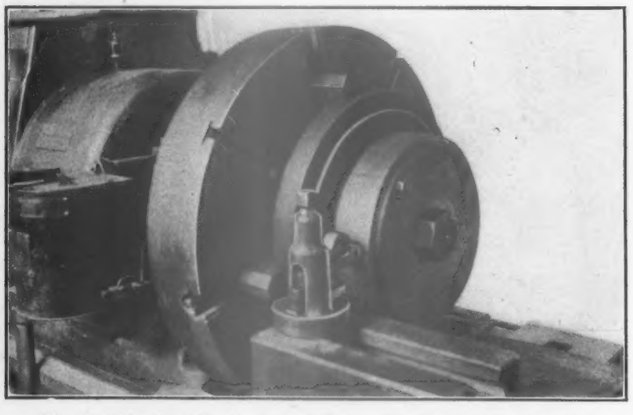


Fig. 6—Turning Mandrel, and Roller for Compressing Rings

Sixth Operation—The packing rings are chucked four at a time for final turning in an engine lathe in the special mandrel shown in Fig. 6. This mandrel is so designed that the rings are held between a base plate in the lathe chuck and a follower plate, the latter being tightened with sufficient pressure to retain the rings in compression by friction between the sides. The rings are first placed in the mandrel and the follower plate tightened slightly. By revolving the mandrel and using the hardened roller illustrated in the lathe tool post, the rings can be gradually compressed until

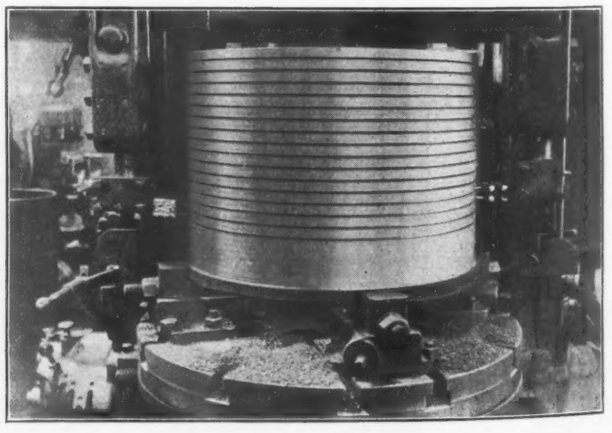


Fig. 7—Cylinder Packing Pot Being Grooved with Two Cutters on Each Side

the ends come together. The roller is then removed from the tool post, replaced by a lathe tool, and the rings turned to the exact diameter of the valve chamber bushings.

By this method of machining, the packing rings have a full bearing in the valve chamber bushings and do not bear at three points as would be the case if the rings were turned larger than the diameter of the bushings and cut so as to get the proper tension against the bushings. Moreover, a

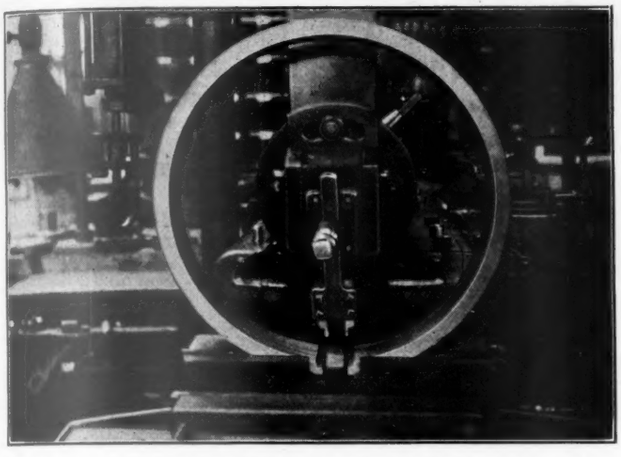


Fig. 8—Valve Packing Chuck Inverted and Used for Holding Cylinder Packing

great many of the old packing rings can be reclaimed by using this method. Rings which have been removed from larger valve chambers are turned down and trued for smaller ones, being then practically as effective as new rings.

The problem of providing cylinder packing for locomotives on any of the larger roads is a difficult one. Unless the proper material is used and correct methods of machining, the life of the packing will be limited and power will be lost, due to steam leakage by the rings. In view of the large number of packing rings used annually, the rings should be produced on a quantity basis with the most careful attention to methods of machining.

Methods of Machining Cylinder Packing

The following practice is adhered to in machining cylinder packing at the Huntington shops:

First Operation—The packing pot is chucked on a vertical boring mill table, using special jaws of the same design as those previously described for holding valve packing rings. The inside and outside of the casting is then machined in accordance with the usual practice, using both heads of the machine at the same time. The inside diameter is made small enough to provide sufficient metal to hold the rings intact while the casting is grooved, after which the rings are bored off.

Second Operation—The entire casting is grooved as shown in Fig. 7, using a double tool in either head. The experience at Huntington shops has shown this method to be much better and quicker than when using four cutting off tools in one head.

Third Operation—The packing rings are faced off on the upper side using one head, the second head being used in boring off the rings.

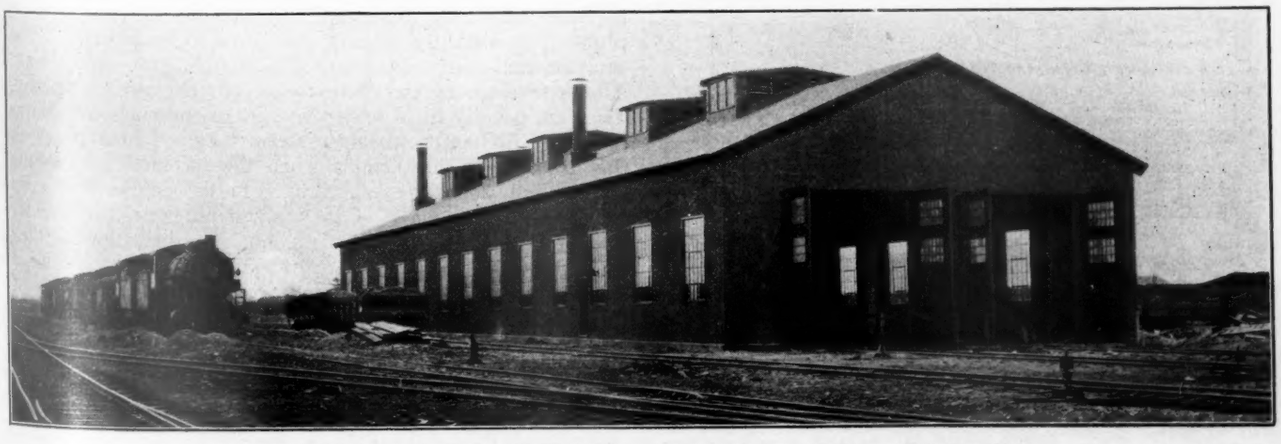
Fourth Operation—The packing rings are then clamped to the boring mill table and faced off one at a time on the unfinished side.

Fifth Operation—The packing rings are placed in a special chuck, after being cut, and machined to suit dowels in the piston head as illustrated in Fig. 8. It will be noted that the chuck in Fig. 8 is the same one shown in Figs. 4 and 5 inverted. Referring to Fig. 5, by inverting block *A*, the large 18-in. radius is brought to the top for holding cylinder packing rings. Liner *D*, used to allow for variations in packing ring width, has the same radius on the bottom as filling block *A* and the two ¾-in. slots allow it to slip on over the dowels and between the end plates *B*. End plates *B* are cut out as shown, so as not to interfere with toolholder and cutting tools *E* as they cut the packing rings.

Particular attention is called to tool holder *E* and the means provided for adjusting the cutting tools. In Fig. 5 the tools are shown in position for cutting 21/32 in. out of rings with 3/16 in. spring. The tools shown are also used for cutting 27/32 in. out of rings with ¼ in. spring by using two of the small 3/32 in. liners illustrated. The liners afford an easy and accurate means of adjusting the cutting tools in toolholder *E*. Two special tools, as shown in Fig. 5, are used when cutting rings with 5/16 in., ⅜ in., 7/16 in., ½ in. and 9/16 in. spring.

Firing-Up Shed

THE firing-up shed illustrated is a new structure recently completed by the Boston & Maine at its locomotive repair shops, North Billerica, Mass. In that latitude climatic conditions are such that cold weather, snow and rain frequently hinder outside work. It was formerly necessary to put the finishing touches on locomotives, fire them up, and make minor changes outdoors after the trial runs, and, in order to protect the men and expedite the work, this firing-up shed was constructed.



New Firing-Up Shed Recently Completed for the Boston & Maine at Billerica Shops

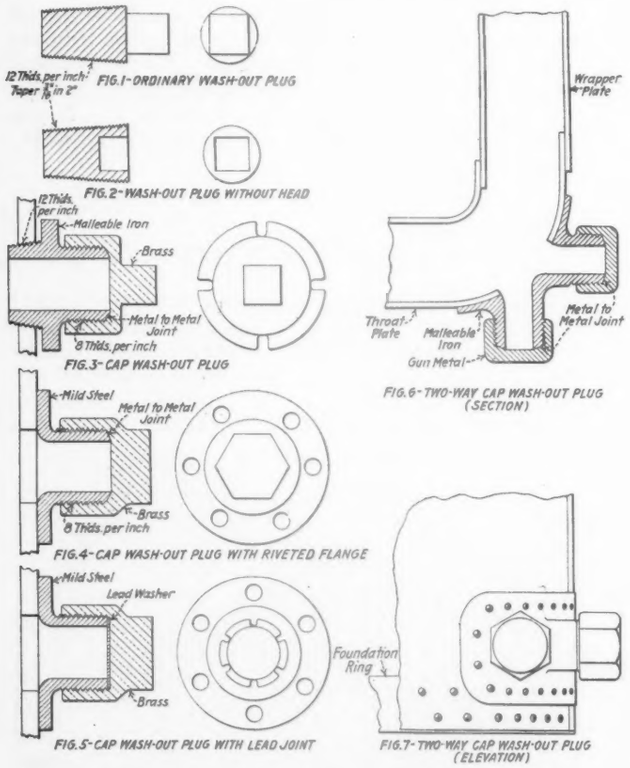
The shed is 209 ft. long by 47 ft. wide, covering two tracks, and holding four locomotives of the largest class with

tenders connected. Steam, compressed air, water and electric light are provided. The building is fireproof throughout. It is proposed to install a small motor-driven lathe, a drill, a small planer, also a blacksmith fire, and this equipment will save countless steps and much time formerly spent running back and forth between locomotives which are being finished and the main machine shop which is located at some distance. Arrangements have been made for smoke jacks to remove the smoke, and electric light extensions in place of smoking oil torches heretofore used will also aid greatly in handling the work. Lockers and toilets are provided for the men and every attempt has been made to provide good working conditions.

Washing Out Locomotive Boilers

By A. Wrench
Crewe, England

BOILER washing is an important branch of locomotive maintenance, which if neglected will impair steaming and cause waste of fuel. The water spaces of locomotive boilers, being narrow and transversed with a large number of stays, soon get blocked up if neglected, especially those parts which are difficult of access or which form a ledge for the accumulation of scale and sediment. Parts situated behind driving wheels are frequently inaccessible for efficient washing out,



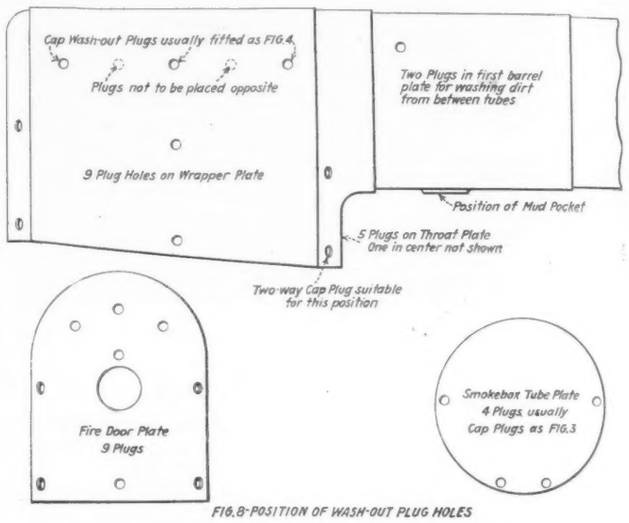
Various Types of Washout Plugs and Caps

and it is in these parts where sediment is most likely to collect.

Scale and sediment also form among the tubes, causing them to leak; become overheated, and collapse. While inspecting boilers in the Ypres sector during the war, the writer found a boiler in which several brass tubes had fused owing to the extremely hard deposit which had been allowed to collect in the boiler.

In most locomotive boilers, washout plugs are placed in difficult positions, the boiler washer having to operate through the spokes of wheels, behind cranks, under foot plates, behind steam and blast pipes and between superheater element tubes. These positions are largely inseparable from locomotive design, but sufficient consideration is often not given to washout facilities.

The use of various shaped nozzles and a good pressure of water is necessary to keep the firebox water spaces clean, but usually it is necessary to remove tubes periodically to keep the barrel clean. A blow-off cock underneath the barrel about two feet from the throat plate will assist in keeping the spaces between the tubes clean if regularly used. Two washout plugs at the bottom of the smokebox tube plate will keep the boiler bottom clean. Some designers fit a washout


Cap Wash-out Plugs usually fitted as FIG.4.
Plugs not to be placed opposite
9 Plug Holes on Wrapper Plate
Two Plugs in first barrel plate for washing dirt from between tubes
Position of Mud Pocket
5 Plugs on Throat Plate One in center not shown
Two-way Cap Plug suitable for this position
Fire Door Plate 9 Plugs
Smokebox Tube Plate 4 Plugs usually Cap Plugs as FIG.3
FIG.8-POSITION OF WASH-OUT PLUG HOLES

Recommended Distribution of Boiler Washout Plugs

plug in the firebox tube plate, but the head of this plug soon burns away and renders it useless. Judging from experience on many types of locomotives of American, British and French make, the writer is of the opinion that washout plugs should be distributed as shown in Fig. 8, which will enable the water spaces to be cleaned and inspected. The use of an electric globe fitted to the end of a wire rod and a mirror is useful when examining water spaces.

Generally handholes are not in favor in locomotive practice, plugs being used in preference. The screwed plug is most extensively used but owing to wear on the threads of the hole caused by the use of the washing out rod, screwed plugs are constantly leaking and have to be refitted. The cap washout plugs overcome this trouble and rarely leak. They are more expensive to make, but cheaper in upkeep. They are usually fitted to the wrapper or covering plate above the inner firebox crown since steam blowing from plugs in this position is conspicuous when the locomotive is in the station and would be a hindrance to the engine driver on the lookout for signals. Cap washout plugs are not usually fitted to the lower firebox parts, but if space allowed, they could be fitted there with advantage as it is on these holes that most wear from using a rod occurs. A disadvantage of this type of plug from a boiler inspector's point of view, lies in the fact that it is more difficult to examine the water spaces through them, than through the screwed hole. The Hunslet Engine Company fitted a two-way washout cap plug to the bottom throat plate positions of the locomotive boilers supplied to the British government during the war, which overcomes the foregoing objection. A sketch of a two-way plug is shown in Figs. 6 and 7.

The pressure of water necessary for running shed washing out purposes is about 60 lb. per sq. in. The hose should be applied in a systematic manner, washing out the highest

parts of the boiler first and finishing the operation by washing the mudring. The water spaces should be inspected by a competent person after washing out is completed. Large locomotives on express service are washed out twice a week after about 700 miles running, but where the blow-off cocks are systematically used, the boilers are washed out weekly.

Boring Mallet Hinge Castings

By J. H. Hahn
Machine Shop Foreman, Norfolk & Western,
Portsmouth, Ohio

THE illustrations show the details of a portable boring bar, designed by A. B. Gift, tool room foreman, for boring the bushing holes in hinge castings on Mallet articulated compound locomotives. Quite a few methods are employed at different shops for boring these castings for application of new articulating pin bushings, but the bar, illustrated in Fig. 1, is one of the best for this purpose that the writer has ever seen, and can also be used for other work such as boring tail bars, deck castings, etc. Much time and labor can be saved by the use of this device.

When boring the holes in hinge castings two five-foot pieces of rail are placed directly under the castings, leveled, and the bar placed in position for boring. The four screws are then run down tight against the rails, holding the bar rigid. The bar is then lined central with the bore, the tool

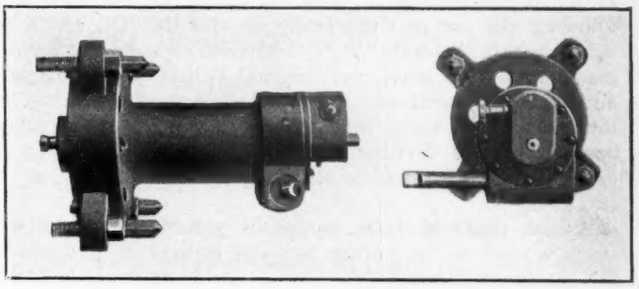


Fig. 1—Side and End Views of Portable Air Motor Driven Device for Boring Mallet Hinge Castings

set for the size of the hole, and motor attached in the usual manner.

Referring to Fig. 2, the body "A" is made of a steel

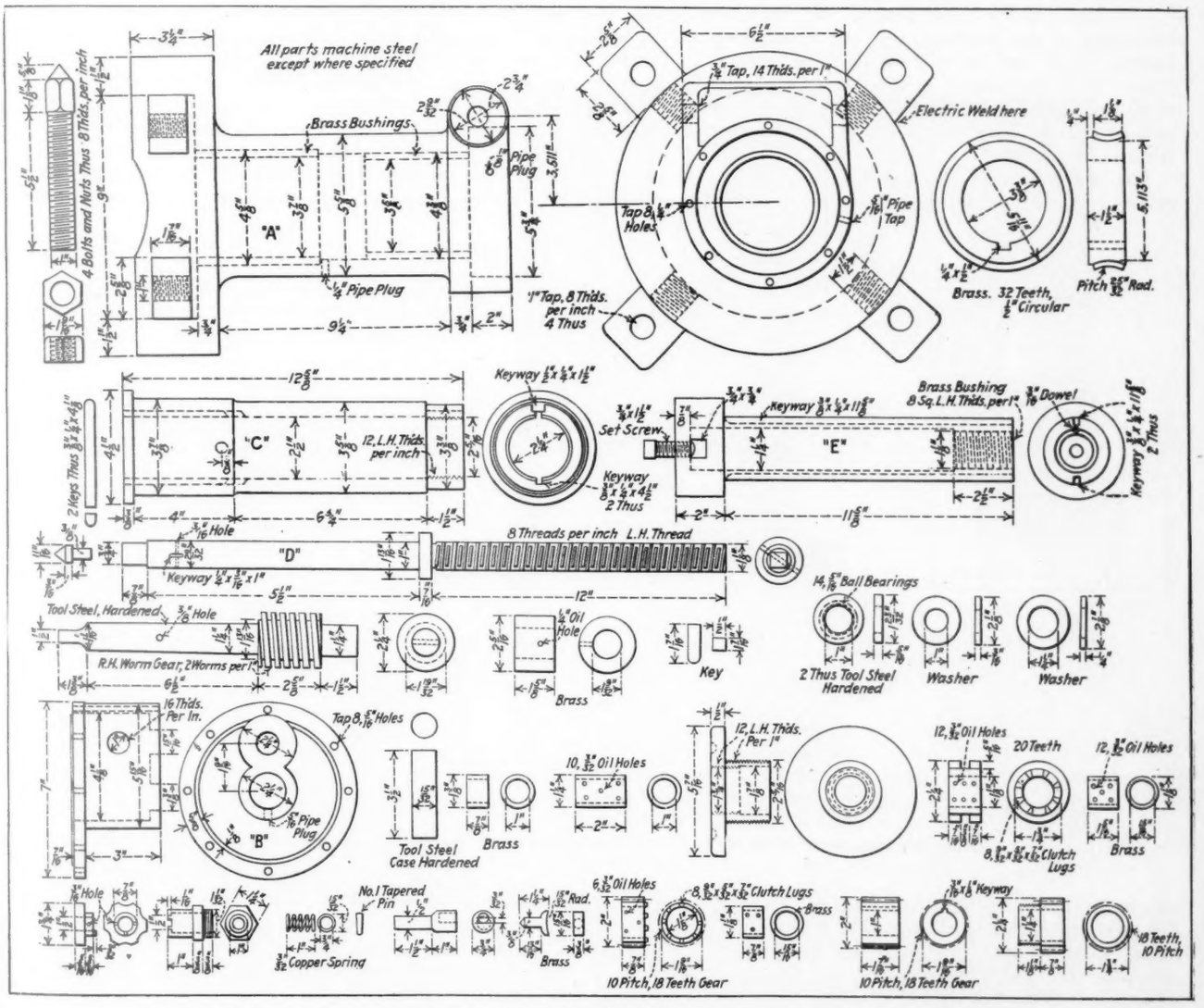


Fig. 2—Details of Portable Boring Bar Used on the Norfolk & Western for Boring Mallet Hinge Castings

forging, machined as shown. Spindle "C" is machined to fit inside the housing, or body "A." Feed screw "D" works in the brass bushing in the end of boring bar "E," this

bushing having a square thread, eight threads per in. Feed screw "D" is driven by a worm drive from the main drive with suitable gears as shown in the drawing. Boring bar "E" has 2 slots milled at 180 degrees for the entire length of the bar to receive a ⅜-in. by ¼-in. key on each side, allowing the bar to slide freely on spindle "C" which revolves within the body "A." The feed arrangement on this machine is of a novel and original design, and is entirely automatic in operation. The feed is put on or started by the small hand wheel shown in Fig. 1. This hand wheel operates a small eccentric which puts the feed gears in mesh, causing the boring bar to slide through the spindle on the two keys.

A tool, made of ¾-in. by ¾-in. square high-speed tool steel, is used in the boring bar and is held in position by the set screw shown. No pilot or guide is used with this machine as the rigid construction of the bar makes this unnecessary. The boring bar is driven by an air motor of proper size and has a speed of about 10 rev. per min., depending of course upon the size of the air motor. The rate of feed with this speed is 1/32 in. per rev.

Feed Control and Drive Arrangement

The illustrations show plainly the construction and arrangement of this machine; also the arrangement of the feed control, drive and the screws used for setting up the machine. The machine is supplied with the required number of oil holes which are plugged by the use of ¼ in. pipe plugs to keep out the dirt, grit, etc. Ball-bearing thrust bearings are also provided.

The gear case and other parts are applied with suitable gaskets to prevent the loss of lubrication. The gear casing, etc., is applied to the body by means of cap screws as shown. All parts are machined all over with limitations of .001 in. to insure accurate fits. All parts are hardened except where otherwise specified, thus reducing the amount of wear to a minimum. Holes are drilled to allow the chips to pass out through the bottom, and this also decreases the weight of the machine considerably. All gears and other moving parts are encased. This bar, with the boring bar shown in drawing, will bore holes through 6-in. castings and by the use of longer bars any desired range may be secured. This machine will prove a valuable addition to any shop handling Mallet type locomotives. It can be constructed in the average railroad shop tool room.

Emergency Seat Refacing Tool

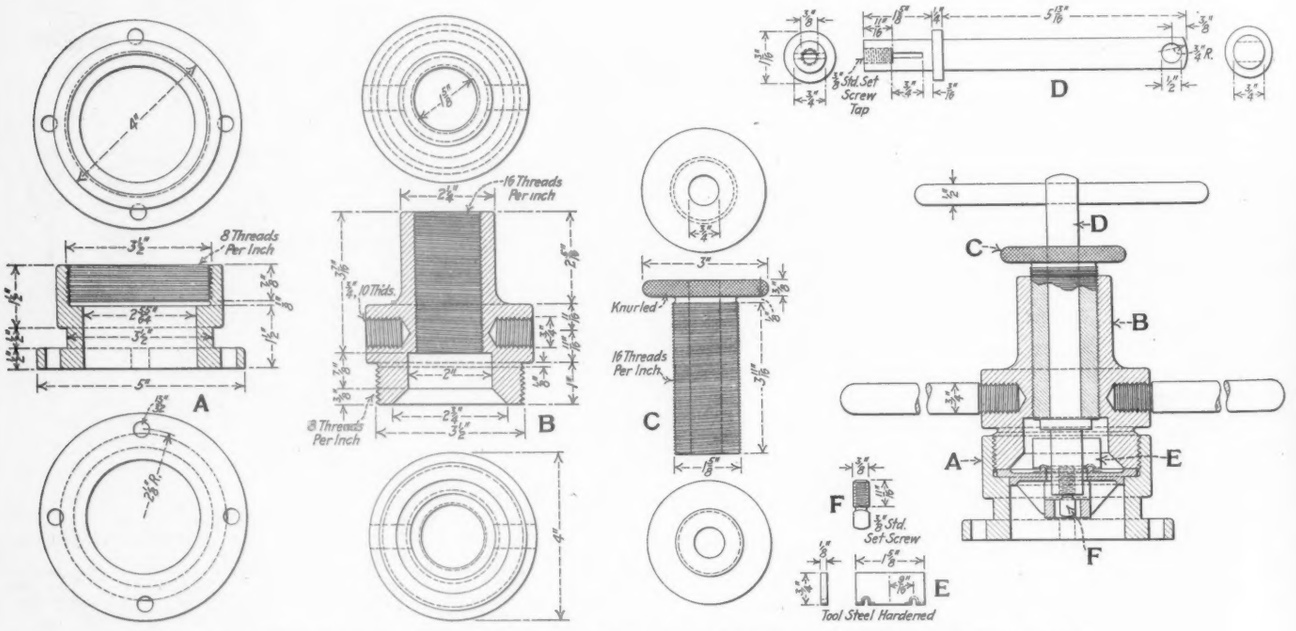
By J. D. Flinner

Supervisor of Air Brakes, Monongahela, Brownsville, Pa.

A TOOL designed to reface the brass emergency valve seats of Westinghouse triple valves is shown in the illustration. This tool can be used for both passenger and freight triple valves in which the emergency valve seats have become worn or cut by long service, causing them to leak. The tool not only refaces worn valve seats but, in the case of some of the older types of valves having flat seats, the seats can be changed, by using the cutter shown, to the new semi-circular section, making a better seat for the rubber-faced emergency valve. It takes only a fraction of a minute to set an emergency valve part in this device and reseat it.

The arrangement and dimensions of the tool are shown in the illustration and, referring to the assembled view, the operation will be evident. The worn brass emergency valve seat is placed in base *A* which is bolted to a bench by four ⅜-in. bolts. The two ¾-in. handles shown enable part *B* to be turned down firmly, holding the emergency valve seat against turning. The feed screw is then run down by means of knurled collar *C* at the top forcing spindle *D* and double cutter *E* downward until the cutter comes in contact with the brass seat. Revolution of spindle *D* by means of its ½-in. handle, accompanied by a slight tightening of the knurled handle on the feed screw, will then cause cutter *E* to give a new, accurate contour to the emergency valve seat. Cutter *E* is removable by loosening set screw *F*. Part *B* should always be screwed down firmly on the seat before beginning the refacing operation.

In shops where many triple valves are repaired, a great deal of time can be saved by this tool, and valve seats which would otherwise have to be scrapped can be used over again. All parts of this tool are made of axle steel except the cutter *E* which is of tool steel hardened.



Details and Assembled View of Tool for Refacing the Emergency Valve Seats of Triple Valves

Examples of Toolroom Work at Readville

Importance of Adequate Toolroom Pointed Out—Effective Tools Made at Readville Toolroom of the New Haven

THERE are doubtless other factors more important in railroad repair shop output than the manufacturing toolroom—but not many. Even the most modern machine shop equipment is rendered largely ineffective without time-saving jigs, fixtures and small tools to provide short cuts, combine operations, and speed up machine work. Besides saving time and consequently the cost of machine work, these jigs and fixtures are incidentally an important

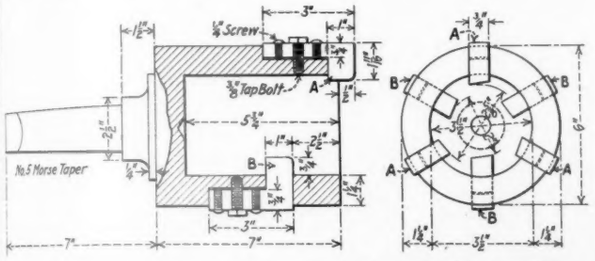


Fig. 1—Partial Section of Box Tool Showing Construction

factor in speeding locomotive parts through the repair shops and hence decreasing the time that locomotives are held out of service.

In view of the above facts, it is important that railroad shops be provided with manufacturing toolrooms in which new jigs and fixtures can be designed and made as needed and old ones kept in good repair. Adequate machine equipment is required in the toolroom and also a personnel with sufficient initiative and resourcefulness to develop new tools

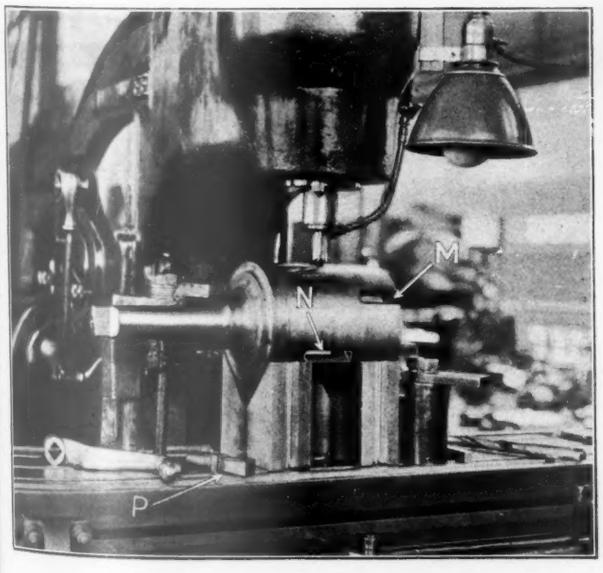


Fig. 2—Milling the Cutter Slots in a Box Tool

as the need for them in various shop departments becomes evident.

The toolroom of the New York, New Haven & Hartford at Readville shops, located in the balcony, is equipped with engine lathes, milling machines, drills, grinders and other standard tools commonly used in toolroom work. A general view of the toolroom is given in Fig. 5 which shows the arrangement of the machinery and the good light available for accurate work. In practically every department of Readville shops, time and labor-saving jigs and fixtures, made in this toolroom, are in daily use.

Box Tool for Turning Eccentric Crank Pins

One of the new tools just being developed is that illustrated in Figs. 1 and 2 for turning Walschaert eccentric crank pins. These pins are forged integral with the eccentric cranks which have a throw of about 19 in. A boring mill with a 38-in. or larger table is, therefore, required to turn eccentric crank pins from 2 to 3 in. in diameter. It is difficult, if not impossible to speed up the boring mill so as to get the required surface speed on the pin and, as a result, the operation takes considerable time besides tying up a heavy machine on a small job.

Realizing the inefficiency of this method, a new plan for

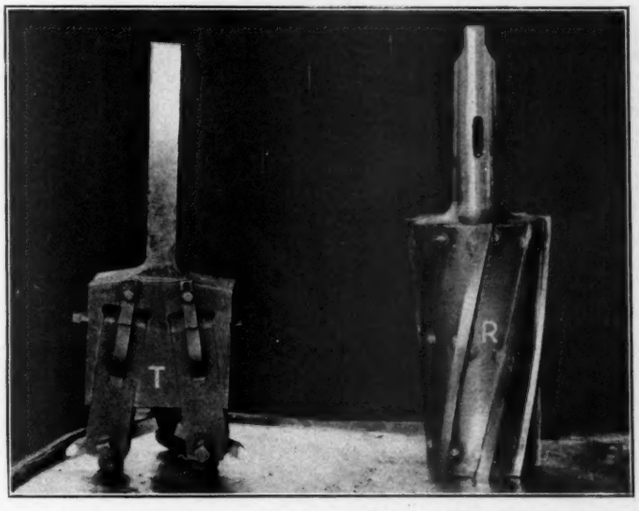


Fig. 3—Two Tools Which Have Proved Their Usefulness

machining eccentric crank pins has been developed at Readville whereby it is proposed to perform the entire operation on whatever drilling machine of the required power may be available. The three cutters *A* (Fig. 1) are designed to turn the pin bearing for the eccentric rod bushing and the three cutters *B* the outer end of the pin which is later threaded to receive the eccentric crank washer and nut. The two turning operations are performed simultaneously by the box tool which is then replaced in the drill spindle by a self-opening die for cutting the thread. It is obvious that the entire operation of machining the eccentric crank pin can be performed by this method in a fraction of the time formerly required.

Referring to Fig. 1, the construction of the box tool will be evident. The three high-speed cutting tools *A* are accurately fitted in slots milled in the body of the box tool. Cutting tools *B* are also made of high-speed steel and accurately fitted in their respective slots. All cutting tools have a slight adjustment by means of the ¼-in. screws, being held against outward movement by the ⅜-in. tap bolts illustrated. The cutters are relieved in two directions so that they can not only turn the outside diameter, but counterbore to give a good side bearing for the eccentric rod bushing. While this box tool was designed for an eccentric crank pin

3 in. long by 2⅝ in. in diameter and with a 2-in. threaded end, the design can be readily changed to suit any size of pin.

The method of machining this box tool may be of interest. In the first place, a forging of the required size was made in the blacksmith shop and turned to the 6-in. outside diameter, a No. 5 Morse taper being formed on one end. A hole was then drilled and bored 3½ in. in diameter and 5¾ in. deep as shown. Slots for the cutting tools were then drilled, milled and broached as shown in Fig. 2. One of the slots for the three cutting tools *A* is indicated at *M*; one of the slots for tool *B* at *N*. An end mill was used for the milling operation and broach *P*, employing the vertical feed of the milling machine, for getting square corners. One precaution should be observed in making tools of this type and that is to machine the slots accurately so that the cutters will not have undue play and work loose under heavy cuts.

Double Cutting Tool and Reamer

One of the operations in machining driving boxes which takes considerable time is what is called "cornering." This consists of machining the shoe and wedge ways slightly wider at the top and bottom than at the center, made necessary to provide for the locomotive rocking from side to side as it goes around curves or difference in the height of opposite wheels. Before "cornering," driving boxes, the shoe and wedge ways are first planed to the standard width, and then a line of boxes is set at a slight angle on the planer table, the required taper cut being taken from opposite ends. The boxes are reset to the same angle the other way and the operation repeated. In all, four cuts are usually taken and these can be reduced to two by means of the double cutting tool illustrated at *T*, Fig. 3. This double cutter was made in the Readville toolroom, the two tool holders consisting of 1½-in. square cold rolled steel in which the ½-in. high-speed steel tool bits are held by the set screws to prevent them from working out. It will be noted that the tool holders are set in the body at angles of 15 deg. so that on the back stroke of the planer they will swing outward, relieving the pressure on the cutting tools in two directions.

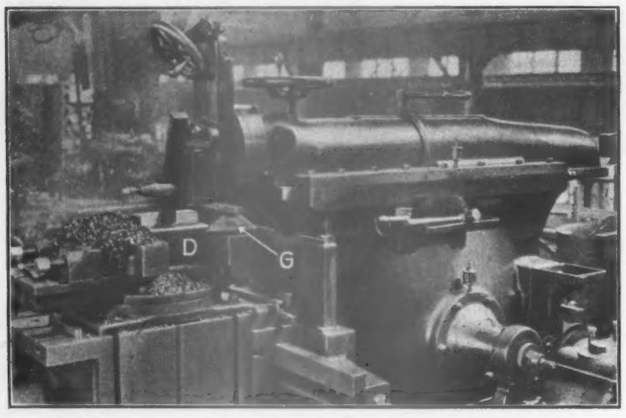


Fig. 4—Modern Shaper Machining Unannealed Die Block

The taper reamer *R* (Fig. 3) was made locally and has demonstrated its value for reaming taper knuckle pin holes in side rods. This reamer is 8 in. long, being 4 in. in diameter at the bottom and 5 in. at the top. It is made with a No. 5 Morse taper shank, having high-speed blades set in a body of soft steel by spot welding as indicated. The blades have the appearance of being spiral but, as a matter of fact, straight cuts were milled in the body of the reamer at an angle of 14 deg. (Obviously these cuts were deeper at the center than at the ends.) Soft high-speed blades were then inserted and the reamer turned in a lathe to give the blades the correct taper. The blades were then taken out, hardened and reapplied permanently by spot welding. The cutting blades were relieved by grinding, the tool then being ready for use and to all intents and purposes as solid as a one-piece high-speed steel reamer. Its cost was relatively much less. Should a question be raised as to the effect of spot welding on the blades, it may be said that the heat is localized and applied for such a short time that it has practically no effect on the heat-treated blades.

One of the machines which receives constant use in the Readville toolroom is the 32-in. heavy duty shaper illustrated in Fig. 4. This illustration is shown for the reason that the die block *D*, held between the chuck jaws, is made of a special die steel unannealed. This die block was to be used in forging spring gibs, one of which is shown at *G* in the illustration, and owing to uncertainty as to the exact analysis of the steel and the required heat treatment, it was decided to machine the die block without annealing. For the shaping operation, a rugged machine was needed and a special high-speed cutting tool had to be used. The shaper illustrated is used for many different operations and on die work the 32-in. stroke is a particular advantage, enabling large dies to be handled.

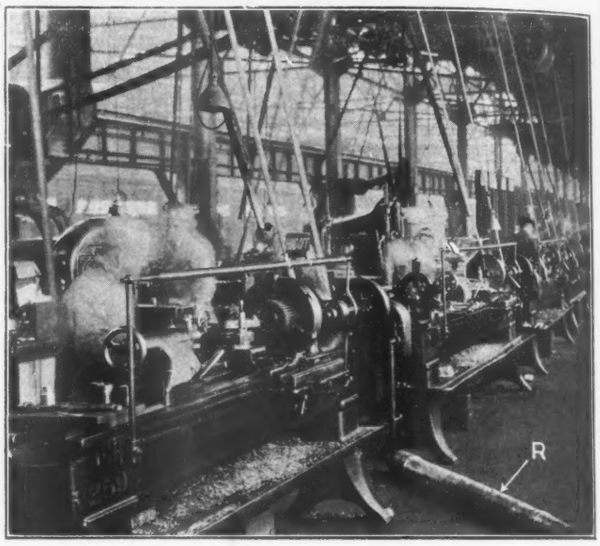
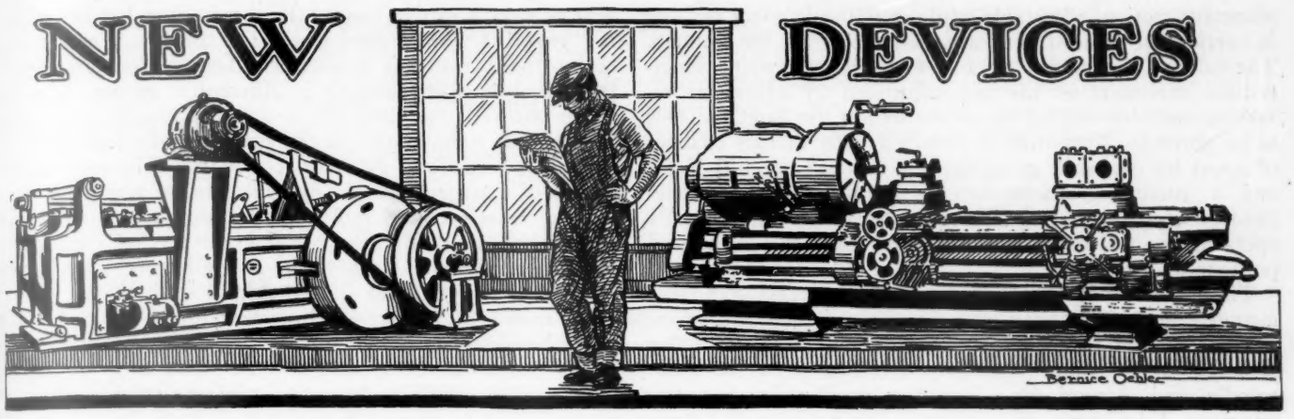


Fig. 5—General View of Toolroom at Readville

Milling Piston Rod Keyways

In addition to what can be classed as strictly tool work, quite a number of operations on locomotive parts are performed in the toolroom at Readville. For example, the piston rod *R*, shown in the foreground of Fig. 5, is one of a pair sent to the toolroom to have the crosshead keyways milled. This rod is 5 in. in diameter, has a keyway 1⅜-in. wide and 4 in. long. The time involved in drilling and filing this keyway, or even machining it with an end milling device, is unnecessarily long and special spiral milling cutters have been made so that the operation can be performed on one of the horizontal-spindle knee-type milling machines in the toolroom. It takes about 10 min. to set up the rod and 20 min. to drill and mill the keyway, one cut only being required. The spiral cutters are supported at both ends so that a relatively heavy feed can be carried. This method of machining keyways is only temporary, however, since it involves moving the piston rods to and from the toolroom. An old end-milling machine, designed especially for machining keyways, is now being rebuilt to drive a spiral milling cutter supported at both ends which is coming to be accepted as the best and quickest means of machining keyways. The rebuilt machine will be located in the machine shop near the piston rod job and thus save trucking new piston rods to the toolroom; also releasing the milling machine for other work.



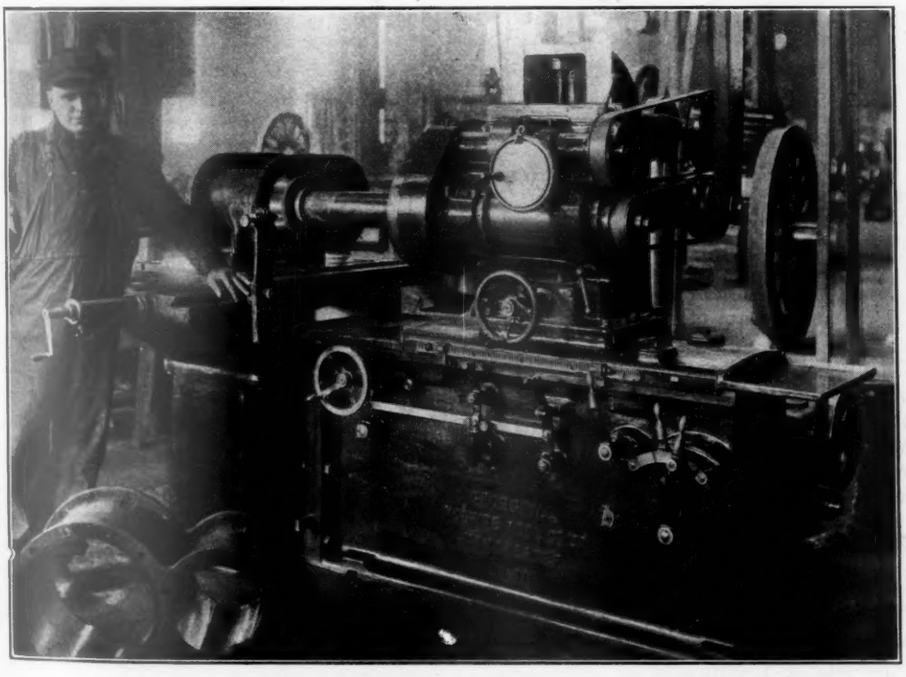
Internal Grinder for Air Compressor Cylinders

THE internal cylinder grinding machine illustrated has been recently introduced in this country by the Churchill Machine Tool Company, Ltd., Manchester, Eng. It is installed in the Hornell shops of the Erie, being used for finishing cylindrical holes quickly, accurately and smoothly. These characteristics are particularly valuable in the case of air compressor cylinders which have to be rebored or trued frequently in order to insure high compressor efficiency.

By grinding new cylinders after rough boring, and retruing used cylinders by grinding only, it is anticipated that a much longer life and consistently higher efficiency will be secured. Bores so treated will prove serviceable for the full period between locomotive shoppings, thereby eliminating one of the causes of idle time in roundhouses, that taken by holding locomotives out of service while new cylinders are being fitted or the original ones rebored.

Precision grinding has in the past been largely considered an unnecessary refinement for railroad repair shops, but there is indisputable evidence that the example of the ground piston rod will soon be extended to other parts that are subjected to intensive local strain and wear. There has never been any serious argument against the regrinding method of resurfacing worm piston rods, and it is but logical to expect that the experience gained with this member will in turn be applied to others of a similar nature.

The illustration shows the grinding of New York duplex air compressor cylinders. In the case of the air cylinders shown on the floor in the foreground, the 8-in. by 12-in. cylinder was ground to a high finish removing .020 in. from the diameter in 20 min. The 14-in. by 12-in. cylinder was ground, removing the same amount of metal in 40 min., the finish and accuracy of the cylinders being greatly superior to the best that can be obtained by any other method.



Churchill No. 2 Internal Grinder Truing Steam Cylinders of a New York Duplex Air Compressor

Features of Churchill No. 2 Internal Grinder

The construction of the machine employed on this work is of considerable interest, as the design is more familiar to engineers on the other side of the Atlantic than to those in this country. The machine is designed, as its name implies, for the grinding of cylinders, bushings and holes in machine parts which, owing to their external shapes, cannot be rotated in the usual internal grinding machines. The machine is of a type that can be used for generating holes in exact relationship and at correct center distances from previously finished locating surfaces or slides thus insuring correct alinement with a minimum of correction by hand work. As the work for which this machine is intended may be of irregular outline, or with overhanging projections, the machine is designed with massive tables with cross adjustment for positioning the work only, the table remaining stationary during the actual grinding. The table is carried on a base reaching directly to the floor, and while coupled to the machine, the table is independent of it so that larger or smaller tables can be fitted to suit various classes of work, or if necessary the table can be removed altogether and a base plate substituted.

The grinding wheel spindle is provided with the necessary

planetary motion, adjustable while grinding is going on, and is carried on a head vertically adjustable on the column. The column is mounted on a slide having automatic longitudinal movement on the bed, controlled by adjustable reversing dogs for varying the stroke to suit the length of hole to be ground. This slide is provided with various changes of speed for use while grinding, and on the Churchill No. 3 and 4 internal grinders there is a quick traverse, independent of the reversing dogs, which can be automatically operated for traversing at high speed over the chambered portions of long holes.

The main spindle on which the grinding wheel spindle is mounted, also has various changes of speed provided, which can be operated independently of the traverse speeds. The grinding wheel spindle is easily detached from the main spindle, and changed for a larger or smaller size in a few minutes. A full range of spindles is obtainable so that holes from the smallest up to the capacity of the machine can be ground.

The planetary motion of the grinding wheel spindle admits of very sensitive control, the controlling handwheel being provided with a dead stop. On the No. 1 and 2 machines the adjustment is obtained through double eccentric spindles controlled through a differential motion. In the larger sizes the adjustment is obtained direct on a slide mounted at right angles to the main spindle and operated through a screw and differential motion. This construction admits of a large range of adjustment to the grinding wheel, so that wheels considerably smaller than the holes to be ground can be used, thus reducing the arc of contact between the wheel and the work, and allowing a very considerable range of wear of the grinding wheel.

By means of the cross adjustment to the table and the vertical adjustment to the spindle, work having a large number of holes can be ground without disturbing the setting on the table. Within the capacity of the machine there is no limitation to the external shape of work to be handled.

The machine is entirely self-contained, and may be driven from a single overhead countershaft or direct-connected to a constant speed motor.

Donomarent Safety Tank Car Outlet Valve

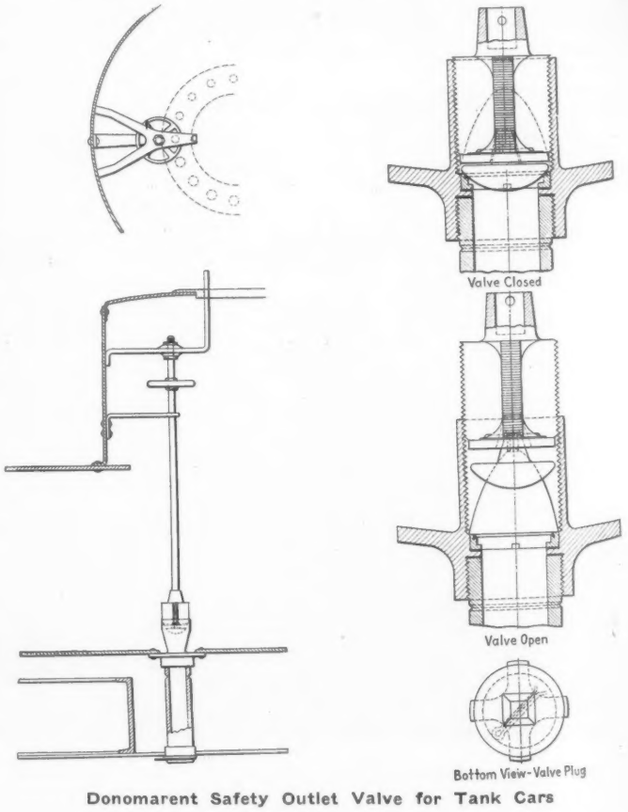
THE present A. R. A. standard type outlet valve and connection for tank cars, judging by the experience of several years, does not embody in its design all the desirable features that such an outlet should possess. Realizing the fact that the present design was faulty, the Bureau of Explosives has endeavored to arouse an interest that would lead to improvements. Several new valves have been brought out, among which is one known as the "Donomarent" outlet, designed by T. J. Entwisle, superintendent car shops, Southern Cotton Oil Company, New Orleans, La., which will apparently overcome several of the objections to the present design.

An ideal tank car outlet and valve is called upon to meet several difficult requirements, among which the following may be mentioned. The seat should be self-cleaning to insure a tight closure; it should be impossible to open the valve without removing the dome cover plate and breaking the seal to prevent pilfering the contents of the car; distortion or "breathing" of the tank should not cause the valve to leak or become wedged and preferably it should be possible to repair a broken outlet without removal of the contents of the car.

Referring to the illustration, it will be noted that the outlet flange is riveted to the bed sheet of the tank in the usual manner while the nozzle is a separate piece. By turning a groove in the nozzle near the end which is screwed into the flange, a point of weakness is provided at which a break will occur should a sufficient force be exerted. In this event, the valve would not be unseated or any of the contents lost. The remaining portion can be readily removed and a new nozzle applied. The flange not being damaged, it would not be necessary to pump out the tank to make repairs.

The separate valve seat is of brass and can be readily unscrewed for reseating or renewal. The valve itself is of spherical shape without wings, thus insuring positive seating and eliminating the danger of cocking. On the upper side of the valve is a tapered square projection which fits into a corresponding socket in the valve plug. The valve plug has four wings, threaded to fit the inwardly extended portion of the flange. The bottom of the plug has a socket for the valve, as stated, the two parts being connected by a cotter or bolt passing through an oblong hole. The design provides a telescoping connection, the effect of which is to cause the valve to be rotated about two and one-half turns after it is seated and before it is locked shut and also as it is opened, before it is lifted from its seat. This will clean off gummy residue, grit or other substances from the seat, insure tight closure and keep the valve and seat in good condition for a long period.

The flanged portion on the lower end of the valve plug is screwed down tight against the valve after it has been closed and makes it impossible for anyone to lift the valve from the seat by a bar or turning tool. The valve can only be opened by breaking the seal and removing the dome cover, a safety precaution against robbery of considerable importance.



Donomarent Safety Outlet Valve for Tank Cars

The extended portion of the flange which forms the valve cage is provided with large openings which give unrestricted flow to the contents of the car and overcomes foaming. The position of the openings and the location of the valve seat insures complete drainage of the full contents of the car.

The upper part of the valve plug is extended to form a

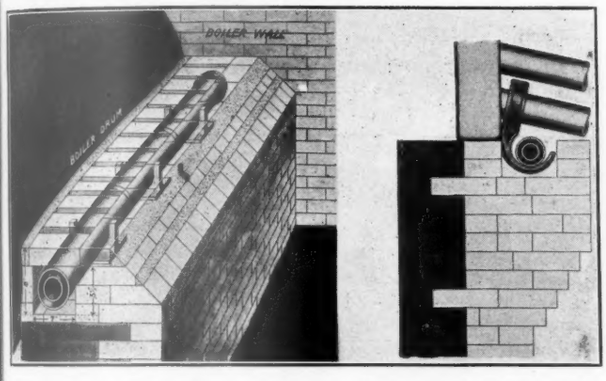
socket for the rod to which the hand wheel is attached. As the threaded connection is between the plug and the cage in the bottom of the tank, distortion of the tank by filling or "breathing" in service cannot cock the valve or wedge it, nor distort or bend the rod. Neither vibration nor contraction and expansion affect the seating of the valve.

The hand wheel rod is extended above the wheel and a position indicating device attached which extends up into the opening of the dome in such a manner that the cover cannot be replaced until the valve is locked shut.

It is stated that these valves have proved entirely satisfactory during the few months that they have been in service and as a result additional valves are being applied to other cars.

Mechanical Soot Blowers for Stationary Boilers

THE value of mechanical soot blowers in increasing the efficiency of boiler operation has been amply demonstrated but certain mechanical difficulties are involved. After an extensive experience the Bayer Company, St. Louis, Mo., has developed a revolving soot blower element which overcomes temperature difficulties by the use of Monel metal and has other valuable features. It is designed to be sectionally air-cooled and non-warpable, thus insuring long life. A valve-in-head arrangement is provided.



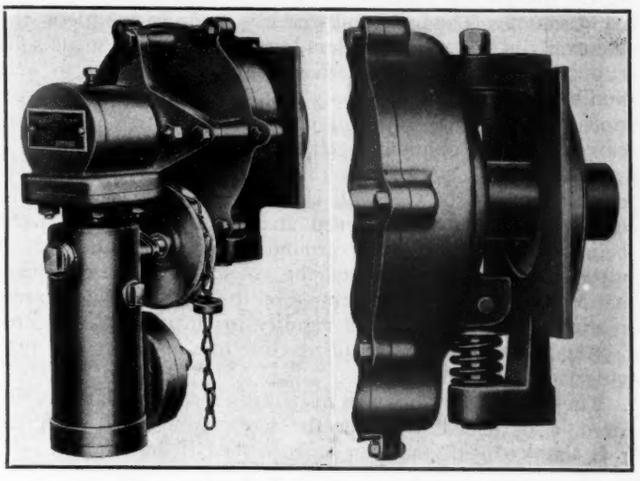
Showing Protected Position of Blower Element in Vertical Boiler (Left) and in Horizontal Water Tube Boiler (Right)

The interior steam element in the Bayer blower is securely locked in a central position within the outer or sectional Monel metal air tube so that both the interior steam element and the outer sectional air tube revolve as one element. This inner steam element is kept free and immune from the high furnace temperatures because it is insulated by a liberal circulating air space through which the high temperatures of the furnace cannot penetrate. Likewise, the outer air tube is kept at a comparatively low temperature due to the positive cooling effect of the circulating air passing through and within it.

The outer air tube is made of Monel metal for unusually high temperatures. Monel metal has been thoroughly tested in comparison with practically all other commercial metals at temperatures up to 1,030 deg. F. The results indicate the distinct superiority of Monel metal as regards both strength and resistance to corrosion.

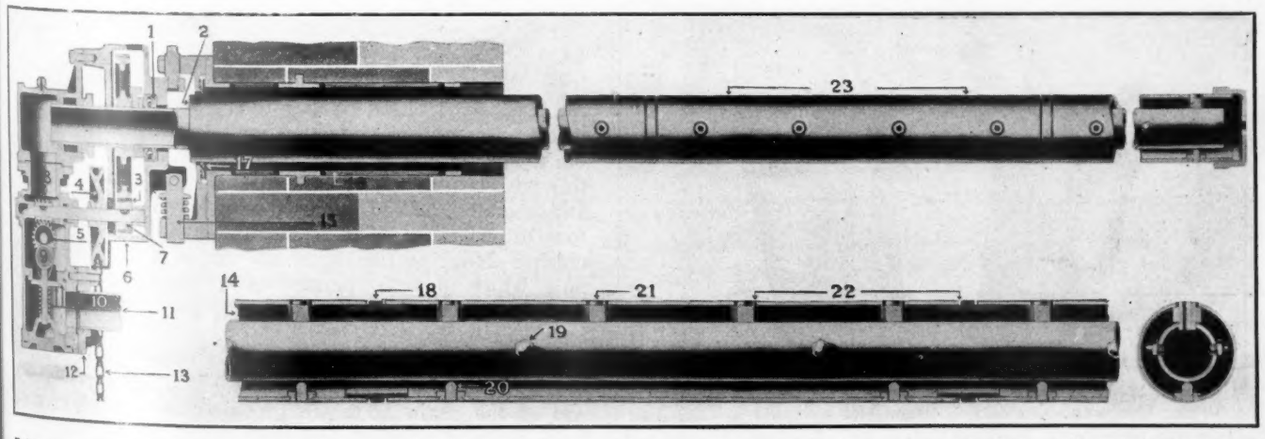
A sectional Monel protecting tube, as well as Monel metal nozzles, are used on this new blower, thus eliminating the danger of oxidation and corrosion of the air tube. To take care of expansion, ample space is provided for each nozzle where it projects through the outer tube.

An additional important feature is the valve-in-head construction of the blower. In this design the valve is in the head itself, as shown in the illustrations, and it automatically opens and closes at the proper points with the rotating of the element.



Bayer Valve-in-Head Geared (Left) Floating Air Shield with Universal Movement (Right)

It is claimed by the manufacturers that this valve cannot leak because it is so constructed that it will always seat per-



Principal Parts of Bayer Soot Blower Unit—(1) Roller and Thrust Bearing, (2) Air Inlet, (3) Gear, (4) Sheave, (5) Cam, (6) Gear Case, (7) Pinion, (8) Bronze Worm, (9) Disk, (10) Monel Metal Valve Parts, (11) Steam Inlet, (12) Flange Connection, (13) Operating Chain, (14) Live Air Space, (15) Full Floating Mechanism, (16) Wall Sleeve, (17) Air Excluding Shield, (18) Expansion Sleeves, (19) Spacers, (20) Studs, (21) Monel Metal Nozzles, (22) Expansion Space, (23) Monel Metal Section Outer, or Air Tube.

fectly. The valve stem does not extend through a stuffing box which might throw the valve out of alinement with its seat and thus cause leakage troubles. The valve is mechanically and positively controlled by a cam and worm gear. The valve also is made of Monel metal.

The elements are so made that they can be rotated in either direction, making it unnecessary to give the elements a second full revolution to repeat the blowing operation when a second revolution is not needed. Steam is thereby saved. Besides, the mechanism is so designed that no steam is wasted, the discharge or blowing of the jet being mechanically timed. The steam jets are blown within a predetermined arc, making it impossible to blow except where necessary and reducing the time required for the operation.

The entire head is "full floating," or in other words, is free to expand or contract with change in temperature and with the expansion and contraction of the boiler walls or the pipe lines. For this reason there is no straining or binding effect in the operating mechanism of the blower. Working parts are not exposed to the grit and dust of the boiler room, the entire blower head being encased. Parts can be oiled without danger of the oil collecting dirt.

A simple and efficient reduction gear makes it impossible to revolve the unit too rapidly. This permits the steam jets to work most effectively on the surfaces to be cleaned during a sufficient period of time. This gear, together with the roller and thrust bearings on which the element is mounted, make the element easy to operate.

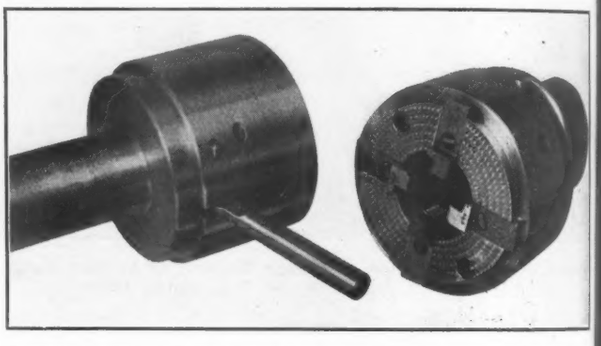
Simplicity and Strength Feature New Hardened Die

THE National Acme Company, Cleveland, Ohio, has added to its line of Namco dies a new hardened die made in revolving and non-revolving types as shown in the illustration. These dies are featured by simple, strong construction. The body and shank is made in one piece, also the cam and cup. The chasers bear directly against the solid cup cam, eliminating numerous small parts subject to wear and loosening. There are only ten parts used in the construction of this die (except for chasers) and there is no face cap to hold the chips and grit.

Special alloy steel is used throughout in the construction of this die and the cup wall is made unusually heavy. The chasers are fitted to hardened and ground plates, all parts being hardened and fully ground. Particular attention is given to the construction of the chasers, all chasers being hardened and lapped and ground on the bottom. The chasers receive full support, giving rigidity in cutting action. Projecting chasers permit threading close to a shoulder and provide freedom from chips.

The shanks for dies are made either soft or hard as desired, a hardened plate for the screw being used with the soft shank. Inside trip can be furnished if desired.

In the revolving type die, five straight thread sizes from 3/16 in. to 2½ in. can be provided; also four sizes of pipe threads from ⅛ in. to ¾ in. In the non-revolving type, seven sizes of straight threads up to 3 in. can be furnished and pipe threads from ⅛ in. to ¾ in.



Namco Hardened Non-Revolving (left) and Revolving (right) Dies

A Two-Speed Ratchet-Operated Screw Jack

AN oscillating lever screw jack which may be operated either in direct or compound leverage, has been placed on the market by the Muelling Engineering Works, Racine, Wis. By the ribbed construction of the body an unusually light weight combined with strength is obtained.

Leverage of Four-to-One—Direct Leverage Position

In lifting, the nut is turned by means of a ratchet-connected lever which operates in a horizontal plane, while the screw does not revolve. The nut revolves on a ball thrust bearing set in a pocket near the top of the jack body. A working fit throughout the length of the body maintains the screw in alinement as the load is raised. This prevents the screw from binding in the nut and adds to the ease of operation.

The illustrations show the two positions of the operating lever. With the handle socket placed on top of the ratchet lever the operator is provided with a one to one leverage ratio which gives a comparatively rapid lift for ordinary loads. For heavy loads the handle socket is placed below the ratchet levers, as shown at the left in the illustration. In this position the handle socket is fulcrumed on the jack body and operates the ratchet lever with a compound leverage of four to one ratio. The ratchet pawl, which engages with a notched flange on the top of the nut is reversed by a finger pull, which may be operated at any point in the stroke of the lever, since the pitch of the screw prevents any possibility of a kick-back.

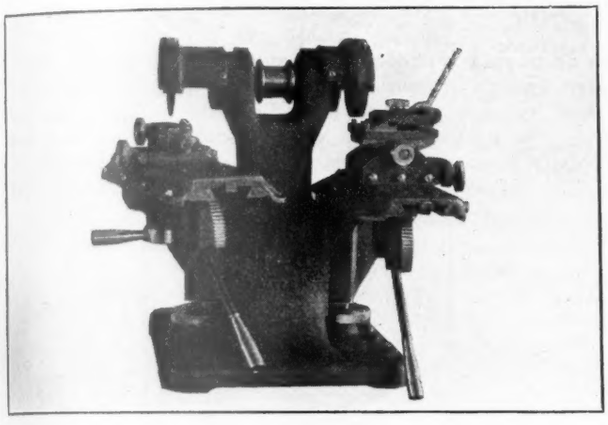
The jack is also furnished with a combined foot lift and chain hook. Lugs on the back of either side of the lower end of the chain hook are provided for the attachment of hardened and polished tool steel rollers, which bear against the faces of the lateral ribs on the jack body. A large ribbed base which may readily be attached to the permanent

base of the jack is provided for use with the foot lift attachment.

These jacks are made in two sizes, of five tons and 10 tons capacity. The smaller jack is 10 in. and the latter 12 in. in height, and they provide for a total raise of eight and nine inches, respectively. Not more than one-half of the rated load should be applied to the foot lift attachment. The two models weigh 20 lb. and 28 lb., respectively.

Grinder for H & G Die Head Chasers

THE Eastern Machine Screw Corporation, New Haven, Conn., has brought out a new machine for grinding chasers used in H. & G. self-opening die heads. The machine is designed as a bench machine, occupying a space of about 20 sq. in. and it stands about 18 in. high. It comes complete with a countershaft and two wheels and, when boxed ready for shipment, weighs approximately 240 lb. The machine has very substantial castings, a ball-bearing spindle and is well protected from abrasive.



Tool for Grinding the Chasers of H & G Self-Opening Die Heads

The left-hand wheel is for grinding the throats, or chamfers. Each chaser is located from a hardened pin that enters the cam slot on the chaser. This locates it just as it is located in the die head. An adjustable anvil provides for long or short chamfers as required. The table swivels to provide the proper curvature and the vise is also provided with an offsetting adjustment. This combination makes it possible to obtain just the right amount of clearance required at the throat.

At the right, the rake angle or angle of cutting face, is ground. Four chasers are held at once by means of a single cam-actuated clamp and the fixture may be tilted to the proper angle.

Too much emphasis cannot be laid on the importance of the proper grinding of tools. A grinder, such as this, reduces the time lost for grinding to a minimum, provides the most efficient grind with the least amount of stock removed from the chasers, and improves the quality of the threading.

Pump Valve Designed to Prevent Leakage

USERS of pumps will be interested in recent improvements in pump valve construction announced by the Worthington Pump & Machinery Corporation, New York. An entirely different form of valve has been designed to eliminate cutting and leakage, thereby increasing the average pump efficiency, decreasing the cost of pumping, and tending to maintain the capacity of the pump at its maximum point.

Fig. 1
Ordinary Hard Rubber Valve After 3 Months' Service

Fig. 2.
Worthington "Seal" Valve After 12 Months' Service

The principal cause of pump leakage is traceable to excessive wear of the rubber valves which, while negligible in some cases, is often quite bad. Thus, Fig. 1 shows a photograph of a hard rubber valve after three months of particularly hard service. Cracks and cuts caused by the valve seat and by the radiating ribs are plainly visible. It is plain that the only way to positively prevent leakage with valves in this condition is to remove and replace them with new valves.

The new Worthington "Seal" valve, illustrated in Figs. 2 and 3, assures absolute tightness when closed, because the rubber used is flexible. It seats perfectly both at the hub and outer rim, its inner and outer seats, and so keeps tight. Age and continuous usage do not cut grooves or cause cracks, as demonstrated in Fig. 2 which shows a flexible rubber seal used for one year in this new type of valve. During the year there was no visible wear, leakage, and no cost for repairs.

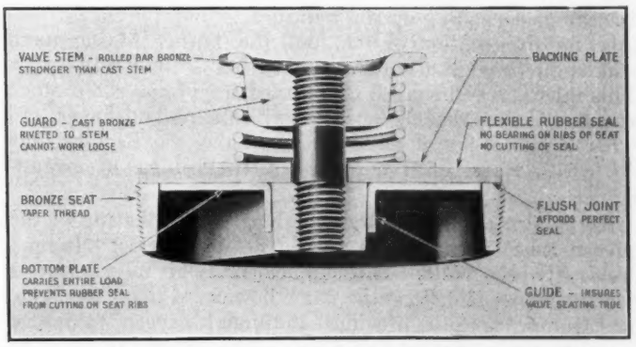

VALVE STEM - ROLLED BAR BRONZE STRONGER THAN CAST STEM
BACKING PLATE
GUARD - CAST BRONZE RIVETED TO STEM CANNOT WORK LOOSE
FLEXIBLE RUBBER SEAL NO BEARING ON RIBS OF SEAT NO CUTTING OF SEAL
BRONZE SEAT TAPER THREAD
FLUSH JOINT AFFORDS PERFECT SEAL
BOTTOM PLATE CARRIES ENTIRE LOAD PREVENTS RUBBER SEAL FROM CUTTING ON SEAT RIBS
GUIDE - INSURES VALVE SEATING TRUE

Fig. 3—Sectional View of Worthigton "Seal" Pump Valve

The ingenuity and simplicity of this valve are evident from Fig. 3. There are no screws, bolts, rubber rings, nuts, bushings, or rotating elements. The special new feature that makes this valve adaptable to hard service is the so-called bottom plate. This is in effect a middle seat for the rub-

ber valve proper. When the valve is closed, this middle seat carries the entire load and prevents the rubber seal from cutting on the seats or ribs. This bottom plate moves up and down with the rubber, and so not only acts as a middle seat, but moves with the rubber and helps to keep the rubber valve in shape, even when open. Thus all mechanical functions requiring strength and wear resistance are cared for by metal parts. The flexible rubber acts only as a seal against leakage. It will be noticed that even the top of the rubber seal is protected by a thin backing plate which keeps the rubber seal flat and prevents any possibility of wear from contact with the spring. All moving parts are light but rigid. The lightness assures a smooth, quiet-running pump. The rigidity prevents the distortion that results in leakage.

It is not anticipated that repairs or replacements will be often required, but the construction makes this easy when it does become necessary and the cost of any possible repairs will be low because of the simplicity and inexpensiveness of all parts. This valve is especially suitable for severe and unusual pumping conditions. It has a proportionately longer life under ordinary conditions.

Blow Torch Designed for Safety and Efficiency

THE Master blow torch, illustrated, is now being marketed by the Turner Brass Works, Sycamore, Ill., and embodies a number of novel and useful features. A safety valve, located at the end of the horizontal pump cylinder, is fitted with a diaphragm accurately proportioned to give away automatically at 40 lb. air pressure. As torches operate at 18 to 20 lb. pressure, this valve will not come into action until about double the normal pressure is present. A thumb-nut on this valve permits the operator to release the air pressure after his work is done, or to decrease the pressure as desired during the operation of the torch.

Another valuable feature is the fact that there is but one opening in the tank. This opening is at the top, above the fuel line, and is sealed by the screw thread filler-plug. By eliminating such soldered connections as burner inlet and upper and lower pump brackets, a frequent cause of leakage trouble is removed.

The pump is equipped with a pump leather that spreads like a parachute on the work-stroke and closes on the return stroke. This leather is automatically lubricated from a reservoir of vaseline in the brass washer at the end of the pump rod.

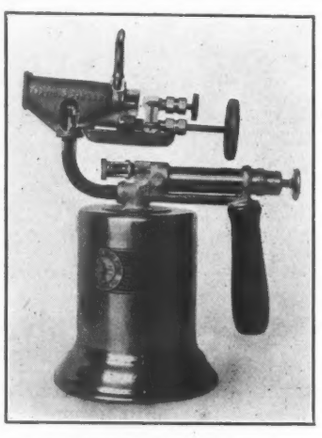
The fuel, in its journey from the tank to the combustion chamber, passes through the interior of a solid bronze baffle in the head, called the "Hot Spot Hump." This baffle is located near the outlet of the burner tube in the path of the flame. It very soon becomes white hot, the intense heat vaporizing the fuel into a hot, dry, highly-inflammable gas. Kerosene or the leanest grade of gasoline can thus be burned.

Efficient combustion means not merely the total consumption of the fuel without unburned residue, but also the maximum admixture and combustion of oxygen from the air. Instead of depending upon a multitude of holes in the burner-tube for oxygenation of the fuel, the Turner Master torch admits air through a flared inlet in front of the needle valve. This inlet is a bell-shaped nut, turned from brass screw-stock and threaded so that the operator with thumb and finger, can screw it into or out of tube, thus regulating the distance from the needle-valve, and consequently, the volume of air admitted.

Air is also admitted through a long slot at the top of the burner tube, immediately above the "Hot Spot Hump," previously referred to. This supplementary air inlet performs two functions; it deflects the flame downward upon the baffle or "Hump," and it provides additional oxygen to insure complete combustion at this point. The absence of holes in the sides of the burner tube is cited by the makers of this torch as one of the reasons why it cannot blow out in a gale of wind.

In blow torches, a very common source of trouble has always been the enlarging of the fuel orifice by strong arm work at the hand-wheel. To checkmate that form of abuse, the shut-off valve is separated from the fuel-control valve, the latter being placed above the shut-off. For the same reason the needle valve has only a small thumb-nut control so as to make it practically impossible for the operator to exert enough pressure to enlarge the orifice. The larger wheel has only one use—that of opening or closing the fuel line. As its valve has a positive seat, there is never any occasion to use force on this wheel.

The Master torch has a wooden pistol-grip handle hung

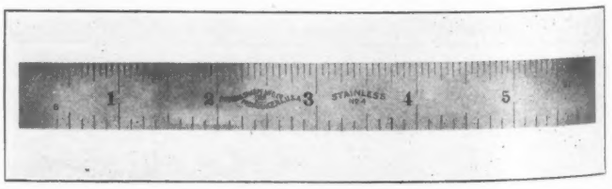


Master Blow Torch

at an angle that balances the torch and at the same time gives ample room for the largest hand so that the knuckles do not nearly touch the tank. The use of a single length of curved steel tubing to carry the fuel from tank to torch eliminates all soldered or threaded joints and connections.

Stainless Steel Rule

A STAINLESS STEEL rule of special interest to mechanics, as well as a great number of foremen and other shopmen, has just been placed on the market by the Browne & Sharpe Mfg. Co., Providence, R. I. This new rule is made of stainless steel so that it is rustproof and will not stain or



Brown & Sharpe 6-In. Stainless Steel Rule

discolor. Every shop man will appreciate the advantage of a rule which always retains its bright finish and thus eliminates the difficulty experienced in reading graduations on rules that have become rusty or blackened from use. The rule is made in 6-in. and 12-in. sizes and is graduated in 8ths, 16th, 32nds and 64ths of an inch.

GENERAL NEWS

The Canadian National will before long establish a pension system for superannuated employees, according to an announcement made by G. P. Graham, Acting Minister of Railways, in Parliament on April 9.

The Atchison, Topeka & Santa Fe announces that employees may become stockholders in the company through a new plan recently adopted. Stock will be purchased in the market by the road and held for employees, who may pay for it at the rate of $10 a month. The limit of stock which may be bought on this plan is 10 shares, either common or preferred.

The use of oil fuel in the locomotives of the Adirondack division, required by New York State law as a precaution against forest fires, costs the New York Central $255,600 yearly, which is about $118,000 more than the probable cost of coal for the same service; and the road has asked the Public Service Commission to modify or suspend the requirements of the law.

A silk banner has been presented to the employees in the Albina (Oregon) shops of the Union Pacific for having made the best safety record in 1922. Only nine injuries were recorded, which was at the rate of 3.72 injuries for each million man-hours of work. This surpasses all other shop records on the Union Pacific and is believed to be one of the best records ever made in a large shop in the United States.

Chinese Road Buys Locomotives in Japan

The Kirin-Changchun Railway, China, has ordered two Mikado type locomotives from the Kawasaki Shipbuilding Yards, Kobe, Japan.

A Tunnel Through Mont Blanc

A new railway line is planned from Oex, Switzerland, on the Bellgarde-Chamonix line, to Aosta, according to the Times (London). The work involves 13 tunnels and 13 bridges. The longest of the tunnels, 15,700 yards, will be through Mont Blanc and will require four or five years in its completion.

Finland to Build Own Railway Equipment

The Finnish State Railways will build 200 open goods wagons and 50 passenger coaches in their own shops, according to advice from Helsingfors to the Times (London) Trade Supplement. In addition 18 locomotives are to be acquired, but whether these will be built in the company's shops or purchased from builders in other countries has not yet been decided.

The "Right to Work Act"

The "Right to Work Act" is the name given to a law which has just been passed by the legislature of Utah, and approved by the governor. This was a bill introduced by Assemblyman A. J. Stookey, and it aims to guarantee to all citizens the right to work, and to prevent other workmen and all agencies from intimidating lawful workers.

Mechanism of Boiler Scale Formation

At the Pittsburgh, Pa., experiment station of the Bureau of Mines, a study is being made of the mechanism of scale formation in steam boilers, including the effect of temperature, pressure, character of surfaces, and concentration of the water. At the present time a continuous test is being conducted on a commercial boiler in actual operation, in which a part of the suspended matter is being continuously removed by an external filter through which the boiler water is circulated. A complete record and account of the scale forming constituents is being kept and the influence of added constituents is being noted.

Mechanical Division Issues Program for June Meeting

The regular annual meeting of the American Railway Association, Mechanical division, will be held at Orchestra Hall, 220 South Michigan avenue, Chicago, on Wednesday, Thursday and Friday, June 20, 21 and 22, 1923. The program is of exceptional interest. In addition to the reports of the committees a number of individual papers have been prepared and the meeting will be addressed by R. H. Aishton, president, American Railway Association; W. W. Atterbury, vice-president, Pennsylvania System; C. H. Markham, president, Illinois Central; W. B. Storey, president, Atchison, Topeka & Santa Fe, and Sir Henry Thornton, president, Canadian National. A list of the individual papers follows:

The Development of the Locomotive by Samuel Vauclain, president, Baldwin Locomotive Works.

The Development of Railway Cars, by E. F. Carry, president, The Pullman Company.

Increasing Locomotive Mileage, by C. F. Giles, superintendent, machinery, Louisville & Nashville.

Training of Apprentices and Supervising Foremen, by John Purcell, assistant to the vice-president, Atchison, Topeka & Santa Fe.

Reports from the following committees will be presented for discussion:

General Committee
Nominating Committee
Arbitration Committee
Committee on Brakes and Brake Equipment
Committee on Car Construction
Committee on Couplers and Draft Gears
Committee on Design of Shops and Engine Terminals
Committee on Electric Rolling Stock
Committee on Loading Rules
Committee on Locomotive and Car Lighting
Committee on Locomotive Design and Construction
Committee on Prices for Labor and Material
Committee on Safety Appliances
Committee on Specifications and Tests for Materials
Committee on Tank Cars
Committee on Wheels

In addition to the committee reports it is planned to provide an opportunity for a free discussion of the following general subjects:

Co-operative Research
Economies from Modern Shop Machinery
Handling of Material on Car Repair Tracks
Modern Repair Track Facilities
Possibilities for Increased Efficiency of Modern Locomotives
Shop Management Problems of Today

All day sessions will be held on each of the three days.

Locomotive Shipments Largest Since 1920

Shipments of railroad locomotives from the principal manufacturing plants increased to 282 in March, and were the highest since December, 1920, according to figures published by the Department of Commerce from compilations of the Bureau of Census. Unfilled orders continued to increase and made a new high record at 2,316 locomotives, an increase of 96 during the month. Unfilled foreign orders increased for the first time since last October.

Wage Increase in the East and West

The Boston & Maine has made an advance in the wages, said to be 3 cents an hour, of about 4,000 trackmen. The Pennsylvania has made advances ranging from 1½ cents to 3½ cents to common laborers in the Northwestern region and certain other sections; but announces that no general increase has been made. The Wheeling & Lake Erie has made advances to large numbers of shopmen, amounting to about 7 cents an hour. Most of these shopmen will now enjoy rates about equal to those enforced before the Labor Board made its reduction. The Illinois Central has

granted increases in pay averaging two cents an hour to the mechanics, helpers and apprentices in the company's shops. The increased rates are retroactive to April 1. Carmen assigned to passenger and freight car truck work are not included in the increase. The Cleveland, Cincinnati, Chicago & St. Louis has announced its intention of increasing the wages of its maintenance of way employees, but has not yet made public the amount of the advance. Section foremen, section laborers and mechanics are included in the increase.

Coupling Devices for South Australian Railways

An important market for coupling devices for the South Australian Railways may be opened in a few months, according to Commerce Reports. The use of heavier engines and heavier trains which the new railway commissioner, who recently was placed in charge of the state railways, plans to introduce during 1923, will require a much stronger and up-to-date coupler than that now in use. As the couplings which will be required when the heavier trains are put into operation are not manufactured in Australia, American manufacturers may have an opportunity to obtain a share of this trade, according to Consul Henry H. Balch, Adelaide, in a report to the Department of Commerce.

Inspection Bureau Finds Defective 64.3 Per Cent of Locomotives Examined

Of 5,368 locomotives inspected by the Bureau of Locomotive Inspection of the Interstate Commerce Commission during March, 3,453 or 64.3 per cent were found defective and 733 were ordered out of service, according to the monthly report of the commission to the President on the condition of railroad equipment. During the same month the Bureau of Safety inspected 109,950 freight cars and found 8.9 per cent defective, and 1,735 passenger cars, of which 2.1 per cent were found defective.

Western Maryland Shops Damaged by Fire

The car shops of the Western Maryland at Hagerstown, Md., were damaged by fire on April 1 to the estimated extent of $300,000. Two large three-story brick buildings, with contents, were practically destroyed. This establishment, employing about 900 men, has been operated for the past year by the Dickson Construction & Repair Company, a contract having been made by the railroad and the construction company following a strike of railway shopmen. A public meeting was held recently in Hagerstown which was described as an observance, by the strikers, of the first anniversary of their walkout.

Chilean Railway Operates First Electric Train

The first electrically-operated train on the Chilean State Railways made a successful trip from Santiago to Tiltil and return on Tuesday, April 17, according to a cablegram received by the Westinghouse Electric & Manufacturing Company. The train was operated by President Alessandri of Chile, as engineman, and the American Ambassador to Chile, was carried as a passenger.

The distance between Santiago and Tiltil is about 30 miles and constitutes the eastern end of the electrified line of 144 miles from Santiago to Valparaiso. When completed, 33 electric locomotives will be used on the electrified section.

Get-Together Banquet on the Central of Georgia

The Metal Trades and Carmen's Associations of the Central of Georgia shops at Savannah, Ga., held a banquet in Savannah on April 14 which was attended by 300 members of the two associations. The foremen and officers of the company also joined with the men, among those present being: L. A. Downs, vice-president and general manager; W. H. Fetner, superintendent motive power; W. H. Wright, superintendent Savannah division, and S. A. Whitehurst, master mechanic. A message was read from President W. A. Winburn, and addresses were made by L. A. Downs, W. H. Fetner, and W. H. Wright. The representatives of the employees' organizations who spoke included W. J. Bice, president; J. C. Williams, vice-president; J. A. Bradford, of Macon shops, and D. F. Hagan, of Savannah shops.

German Diesel Locomotives for Russia

The chief of the Russian railway commission in Berlin is reported to have contracted with the Deutsche Werke for the construction of a number of Diesel-engined locomotives, according to Consul Richardson at Berlin. The first two, one with electric and the other with hydraulic transmission, must be delivered during the summer of 1923.

These new locomotives will cost approximately twice as much as steam locomotives, but they have the advantage, among others, of being capable of operation without water—a distinct improvement in a country where water is scarce. This feature will permit the extension of railways into sections of Russia where now they are nonexistent.

Court of Appeals Renders Decision in Patent Suit Involving Corrugated Steel Car Ends

The United States Circuit Court of Appeals for the Seventh Circuit has modified the decree of the District Court in the suit of the Pressed Steel Manufacturing Company, Chicago, and Walter P. Murphy, against the Mt. Vernon Car Manufacturing Company, Mt. Vernon, Ill., for patent infringement. The patents involved are the Murphy-Sisson patent No. 1,031,571, claims 11, 12, 14 and 15; Sisson reissue patent No. 14,434, claims 9, 12 and 43; Murphy patent No. 1,058,889, claim 5; Sisson patent No. 1,271,234, claim 1; and Sisson patent No. 1,254,860, claims 2, 3, 4, 5 and 6. In that suit the District Court decided in favor of the plaintiff that all of the claims of these patents involved in the suit were valid and had been infringed by the Mt. Vernon Car Manufacturing Company in equipping 1,000 box cars for the Baltimore & Ohio, with corrugated steel plate ends furnished by the Chicago-Cleveland Car Roofing Company, and issued an order for a permanent injunction and an accounting as to profit and damages against the defendant company. The decision of the Circuit Court of Appeals modifies the decree of the lower court by relieving the defendant from the injunction and accounting under the disputed claims of patents No. 1,058,889, No. 1,271,234, and Claims 9 and 12 of reissue patent No. 14,434. So modified, the decision of the lower court is affirmed. The Court of Appeals says: "Each side shall pay one-half of the costs in this court."

Railway Construction in Colombia

Work is progressing on the extension of the Ferrocarril del Pacifico (Pacific Railroad) northward from Buenaventura, Colombia, to Cartago, department of El Valle del Cauca, according to Vice-Consul McEnelly at Buenaventura. The length of the line already in operation is 190 miles, and an extension of 127 miles is planned for the next two years. The railroad is of 3-ft. gage and is owned and operated by the Colombian government, under the direction of the ministry of public works.

The ministry has fixed as the equipment necessary for each 25 miles of the Pacific Railroad 4 locomotives, 8 passenger cars, 10 box cars, 2 live-stock cars, 8 flat cars, 2 gondolas, and 5 dump cars. According to the chief engineer of the railroad, the present rolling stock consists of 25 locomotives (16 of the Mogul type), 40 passenger cars, 60 box cars, 13 live-stock cars, 60 flat cars, 32 gondolas, and 50 dump cars. Provided the extension planned for the next two years is completed, the following equipment will be needed: 27 locomotives, 64 passenger cars, 70 box cars, 13 live-stock cars, 44 flat cars, and 15 dump cars.

Consolidated Equipment Repairs for Short Line Association

Negotiations have been concluded through the efforts of J. W. Cain, manager of the purchases of the American Short Line Railroad Association, between the association's banking interests and the Midwest Engine Corporation of Indianapolis, Ind., covering an extensive rebuilding program for used locomotives and freight cars. The program will call for the general overhauling of 108 locomotives and the rebuilding of 3,600 freight cars each year for the next five years. The plan is an outcome of the investigation of the feasibility of building several thousand cars of standard design which could be financed on a consolidated

basis and allocated to the individual lines of the American Short Line Railroad Association.

The freight cars will be financed on a basis of approximately 25 per cent cash and the balance by car trust notes extending over five years. Locomotives will require one-third cash and the balance will extend from one to two years. When the requirements of a road are not sufficient to justify the economical handling of an individual issue a grouping will be made and the total equipment will be covered by one general trust agreement. Equipment will be rebuilt in a manner satisfactory to the banking syndicate as suitable collateral.

Where conditions warrant freight cars are to be rebuilt with steel center sills or draft arms, friction draft gear, outside metal roofs and other specialties. Locomotives will be superheated or otherwise equipped with fuel saving devices. Parts of the plant of the Midwest Engine Corporation will be devoted to freight car and locomotive repairing. The freight car repairing is expected to start within 60 days. Locomotive repairing will start July 1. H. C. May, formerly superintendent of motive power of the Monon and the Lehigh Valley, has been elected president of the new company. A. J. Canfield, formerly of the Canadian Car & Foundry Company, will be in charge of the car department. Ferdinand Barnickol, president of the Indianapolis Drop Forging Company, has been elected chairman of the board of directors, other directors are A. Rosenthal, H. C. Purdy, L. M. Rappaport and J. Wood.

American Electric Locomotives for Spain

Three of the six 100-ton, 3,000-volt d. c. electric locomotives, comprising part of the $1,500,000 contract for the electrification of 40 miles of the Spanish Northern Railway, were shipped by the International General Electric Company on the S. S. Florinda (Garcia & Diaz, agents) on April 9 from South Brooklyn, N. Y., in the presence of a party of engineers and officials, including the Spanish consul general and his staff.

The electrification for which this equipment is supplied will be carried out by the Sociedad Iberica de Construcciones Electricas of Madrid, Spanish representatives of the International General Electric Company, and is of particular interest because it is the first 3,000-volt direct current road to be installed in Europe. It is known as the Pajares Grande division.

These locomotives are of particular interest, since they are a somewhat novel design, using three axles instead of the usual two-axle trucks. They are of the swivel truck type and each is equipped with six 400 hp. motors, giving a capacity sufficient to handle a full tonnage train up the 2 per cent grades at 22 miles per hour. On the return trip the trains will be held by the regenerative braking.

In addition to the locomotives, the contracts placed with the Spanish company include equipment of two 300 kw. substations and material for overhead distribution for the entire electric zone. Shipment of this latter equipment has already been made and is being installed by the Spanish company.

Italy Plans to Lease Railways to Private Concerns

The Italian government is planning the details of the contracts under which the railways are to be turned over to private concerns, according to Rome dispatches to the New York Times.

The fundamental principles are that private enterprise will take the roads on leases lasting for a number of years, agreeing by contract with the government how much capital must be set aside as a guarantee of the solvency of the companies, or buying reserve material and for general expenses. Private enterprise is to get 7 per cent interest on this capital and to divide everything over 7 per cent with the government in a ratio to be decided upon.

The roads will pass to private enterprise completely. Private companies will not merely administer them for the government, but must assume full responsibility. This leads to the necessity that the roads be ceded for long terms of years, so that private enterprise may have a sufficient period to run them under normal conditions after the inevitable period of transformation and settling down. It will be possible for private enterprise to denounce the contracts if the economic conditions on which they are based prove to be fallacious.

The government will hand over the railroads in their present state. Private enterprise will have to see to upkeep and rolling stock and to return the roads at the end of the contract period in the same condition. There will be full liberty to run the railroads in whatever way private enterprise thinks best, and it will have the right to decide on the number of the personnel to be employed. The government, therefore, breaks its present contract with its employees, but private enterprise must choose nine-tenths of the employees from the present railroad staffs. There will be full liberty in regard to wages to the employees, provided there is a guarantee of wages for five years and of stable employment to all specialized workmen. The approval of the government must be obtained for proposals as to the juridical status of the employees.

MEETINGS AND CONVENTIONS

Fuel Association Convention Papers

A well-rounded program of interest to railroad officers and coal operators has been arranged for the annual meeting of the International Railway Fuel Association to be held at the Hotel Winton, Cleveland, Ohio, May 21-24. The following list gives the addresses, papers and reports which have already been definitely arranged. The invocation will be delivered by Rev. John G. Hindley, pastor of the East Cleveland Congregational Church. T. K. Maher, president of the Maher Collieries Company, Cleveland, will deliver the address of welcome, which will be followed by the opening address by Julius Kruttschnitt, chairman of the executive committee of the Southern Pacific. Mr. Kruttschnitt has chosen as his subject Railway Fuel—A Reducible 13 per Cent of Operating Expenses. H. M. Griggs, manager of the Ore & Coal Exchange, Cleveland, will address the convention on Lake Coal Handling, and C. E. Maurer, president of the Glens Run Coal Company, will deliver an address on a subject to be selected later.

The subjects of the individual papers and the authors are as follows: Extension of Locomotive Runs, C. B. Peck, western mechanical editor, Railway Age; Economic Aspects of the Fuel Oil Situation, C. E. Beecher, acting chief petroleum technologist, U. S. Bureau of Mines; Incentives for Promoting Fuel Economy, O. S. Beyer, Jr., consulting engineer; Classification of Coals, Geo. H. Cushing, publisher, Cushing's Survey; The Fuel Saving Aspect of Boiler Water Treatment, C. R. Knowles, superintendent water service, Illinois Central; The Effect of Tonnage Rating and Speed on Fuel Consumption, J. E. Davenport, superintendent fuel and locomotive performance, New York Central; The Other Ten Per Cent, R. S. Twogood, assistant engineer, Southern Pacific; The Superheater—Its Use and Abuse from a Fuel Economy Standpoint, Bard Browne, service engineer, the Superheater Company; Refractories for Oil-Burning Locomotives, J. C. Martin, Jr., vice-president, Ætna Combustion Company; Economy in the Heating of Stations and Buildings, R. W. Noland, professor of heating and ventilating, Purdue University; Value of Individual Performance Record, L. G. Plant, editor Railway Review.

The following standing committees will also present reports: Firing Practice (Chairman S. H. Bray, Southern Pacific); Fuel Accounting, Distribution and Statistics (Chairman B. A. McDowell, Baltimore & Ohio); Fuel Stations (Chairman W. E. Dunham, Chicago & North Western); Front Ends, Grates and Ash Pans (Chairman Prof. E. C. Schmidt, University of Illinois); Boiler Feed Water Heaters (Chairman E. E. Chapman, Atchison, Topeka & Santa Fe). The Committee on Storage Coal, of which the late Prof. H. H. Stoek was chairman, will also present a report.

Papers for Purchases and Stores Meeting

The Purchases and Stores Division of the American Railway Association will hold its fourth annual meeting at Chicago, May 15-17, the headquarters being at the Hotel Sherman. The sessions will be held in the convention hall of the hotel, convening at 9.30 a. m., city time, on Tuesday, May 15. The subjects of the committee reports and papers to be presented are as follows: Stores Department Book of Rules (Chairman W. D. Stokes, Illinois Central); Classification of Material (Chairman W. L. Hunker, Chicago, Rock Island & Pacific); Reclamation and Conservation of Discarded Material and Classification of Scrap (Chairman A. S. McKelligon, Southern Pacific); Material Accounting and Office Appliances (Chairman G. A. Secor, Chicago & Alton); Forest Products (Chairman W. A. Summerhays,

Illinois Central); Stores Department Buildings and Facilities for Handling Material (Chairman R. C. Harris, Pennsylvania System); Workable Rules in Connection with the Carrying Out of the Provisions of Section 10 of the Clayton Anti-Trust Act (Chairman E. A. Clifford, Atchison, Topeka & Santa Fe); Supply Train Operation and Line Delivery of Material (Chairman O. Nelson, Union Pacific); Joint Committee on Fuel Conservation (Chairman S. Porcher, Pennsylvania System); Joint Committee on Joint Inspection of Standard Material (Chairman M. J. Collins, Atchison, Topeka & Santa Fe); Unit Piling of Material and Numerical Marking System (Chairman J. L. Sullivan, Union Pacific); Purchasing Agents' Office Records and Office Organization (Chairman C. E. Walsh, Pennsylvania System); Committee on General Accounting (Chairman H. H. Laughton, Southern Railway); Store Delivery of Material to Users at Shops (Chairman H. R. Duncan, Chicago, Burlington & Quincy); Nominating Committee (Chairman F. A. Bushnell, Great Northern); Most Economical Method of Handling Repairs to Typewriters, Calculating Machines and Other Office Appliances, W. W. Griswold, stationer, Chicago, Rock Island & Pacific; Reclamation of Grain Doors, Oliver Maxey, general supervisor claim prevention, Chicago, Rock Island & Pacific; Savings to Be Effected in the Handling of Paints, Oils and Similar Products by the Use of the Metal "One Time" Shipping Container, J. C. Kirk, assistant general storekeeper, Chicago, Rock Island & Pacific; The Railway Stores Catalogue, C. D. Young, general supervisor of stores, Pennsylvania System; The Need of Apprentices in the Storehouse Organization, J. W. Gerber, general storekeeper, Southern Railway.

The following list gives names of secretaries, dates of next or regular meetings and places of meeting of mechanical associations and railroad clubs:

Air-Brake Association.—F. M. Nelis, Room 3014, 165 Broadway, New York City. 1923 annual convention; Denver, May 1 to 4 inclusive.

American Railroad Master Tinners', Coppersmiths' and Pipefitters' Association.—C. Borcherdt, 202 North Hamilton Ave., Chicago.

American Railway Association, Division V—Mechanical.—V. R. Hawthorne, 431 South Dearborn St., Chicago. Annual meeting, Orchestra Hall, 220 South Michigan Ave., Chicago, beginning June 20, 1923.

Division V—Equipment Painting Division.—V. R. Hawthorne, Chicago.

Division VI—Purchases and Stores.—W. J. Farrell, 30 Vesey St., New York. Next meeting, Chicago, May 22, 1923. Annual meeting, Hotel Sherman, Chicago, May 15, 16 and 17, 1923.

American Railway Tool Foremen's Association.—R. D. Fletcher, 1145 E. Marquette Road, Chicago.

American Society of Mechanical Engineers.—Calvin W. Rice, 29 W. Thirty-ninth St., New York. Railroad Division, A. F. Stuebing, 30 Church St., New York.

American Society for Testing Materials.—C. L. Warwick, University of Pennsylvania, Philadelphia, Pa. Annual meeting, Chalfonte-Haddon Hall Hotels Atlantic City, N. J., beginning June 25, 1923.

American Society for Steel Treating.—W. H. Eiseman, 4600 Prospect Ave., Cleveland, Ohio.

Association of Railway Electrical Engineers.—Joseph A. Andreucetti, C. & N. W., Room 411, C. & N. W. Station, Chicago, Ill.

Canadian Railway Club.—W. A. Booth, 53 Rushbrook St., Montreal, Que. Next meeting May 8. Annual meeting election of officers, Grand smoker and entertainment.

Car Foremen's Association of Chicago.—Aaron Kline, 626 N. Pine Ave., Chicago, Ill. Meeting second Monday in month, except June, July and August, Great Northern Hotel, Chicago, Ill.

Car Foremen's Association of St. Louis.—Thomas B. Koeneke, 604 Federal Reserve Bank Building, St. Louis, Mo.

Central Railway Club.—H. D. Vought, 26 Cortlandt St., New York, N. Y. Next meeting May 10. Paper on The Modern By-Product Coke Oven and Its Application will be presented by C. Ramsburg, vice-president, Koppers Company, Pittsburgh. Film pictures and lantern slides.

Cheif Interchange Car Inspectors' and Car Foremen's Association.—W. P. Elliott, T. R. R. A. of St. Louis, East St. Louis, Ill.

Cincinnati Railway Club.—W. C. Cooder, Union Central Building, Cincinnati, Ohio. Next meeting May 8. Paper on Automatic Train Control will be presented by W. Gordon Fisher. Luncheon.

International Railroad Master Blacksmiths' Association.—W. J. Mayer, Michigan Central, 2347 Clark Ave., Detroit, Mich.

International Railway Fuel Association.—J. G. Crawford, 702 East Fifty-first St., Chicago, Ill. Next meeting, May 21-24, 1923, Cleveland, Ohio.

International Railway General Foremen's Association.—William Hall, 1061 W. Wabash Ave., Winona, Minn. Annual convention, Hotel Sherman, Chicago, September 4-7, 1923.

Master Boilermakers' Association.—Harry D. Vought, 26 Cortlandt St., New York, N. Y. Annual convention, Hotel Fuller, Detroit, Mich., May 22 to 25 inclusive, 1923.

New England Railroad Club.—W. E. Cade, Jr., 683 Atlantic Ave., Boston, Mass. Next meeting May 8, Copley-Plaza Hotel. Paper on Use of Compressed Air in Track Maintenance and Construction will be presented by W. H. Armstrong, manager sales, Ingersoll-Rand Company. Illustrated by moving pictures.

New York Railway Club.—H. D. Vought, 26 Cortlandt St., New York.

Niagara Frontier Car Men's Association.—George A. J. Hochgreb, 623 Brisbane Building, Buffalo, N. Y.

Pacific Railway Club.—W. S. Wollner, 64 Pine St., San Francisco, Cal.

Railway Club of Pittsburgh.—J. D. Conway, 515 Grandview Ave., Pittsburgh, Pa.

St. Louis Railway Club.—B. W. Frauenthal, Union Station, St. Louis, Mo.

Traveling Engineers' Association.—W. O. Thompson, 1177 East Ninety-eighth St., Cleveland, Ohio.

Western Railway Club.—Bruce V. Crandall, 605 North Michigan Ave., Chicago. Annual meeting May 21 at 5:00 p. m. Election of officers and directors.

SUPPLY TRADE NOTES

W. J. Hyman has been appointed a vice-president of the International Equipment Company, Ltd., Montreal, Quebec.

The Chicago Railway Equipment Company has moved its general sales office to 500 Railway Exchange building, Chicago, Ill.

Charles A. Maher, vice-president of the National Car Wheel Company, Cleveland, Ohio, died in a hospital in that city on April 7.

The Indianapolis Steel Products Company will construct a one-story plant, 100 ft. by 200 ft., at Palestine, Ind., to cost approximately $100,000.

The Pullman Company will construct a one-story car shop at Cottage Grove avenue and One Hundred and Third street, Chicago, to cost $40,000.

Clifford F. Messinger for the past three years general sales manager of the Chain Belt Company, Milwaukee, Wis., has been elected second vice-president.

The corporate name of the Fairmont Gas Engine & Railway Motor Car Company has been changed to Fairmont Railway Motors, Inc., Fairmont, Minn.

The General Electric Company will build a five-story building at Third and Antoinette streets, Detroit, to be used for general mechanical and operating service.

The Kirby-Bonner Lumber Company, Houston, Texas, has removed its eastern sales offices from 120 Broadway to room 2612 Grand Central Terminal, New York City.

C. S. Williamson, formerly vice-president of the Meade-Morrison Manufacturing Company, Chicago, died at his home in that city on March 31, from pneumonia.

A. W. Berghoefer has again become associated with the Gifford-Wood Company, Hudson, N. Y., and will be located at the company's New York City office, 50 Church street.

The Standard Railway Equipment Company and the Union Metal Products Company have removed their New York City office from 347 Madison avenue to 247 Park avenue.

W. J. Roehl has been appointed representative in the southwest territory for the Locomotive Lubricator Company, with headquarters in the Railway Exchange building, St. Louis, Mo.

Dr. C. W. Gould, western manager of the Gould Coupler Company, died at his home in Chicago on February 19. He had been connected with the Gould Coupler Company for the past 30 years.

Percy M. Elliott, president of the Camel Company, Chicago, and vice-president of the Ryan Car Company, died at the Henrotin Memorial Hospital, Chicago, on April 18 after a prolonged illness.

E. W. Stone, signal foreman on the Southern Pacific at Oakland, Cal., has been appointed construction engineer of the National Safety Appliance Company, with headquarters at Chicago.

Francis L. Bullard, formerly treasurer of the Hinckley Locomotive Works and later of the Rhode Island Locomotive Works, died on April 2, at his home in Wellesley Hills, Mass., at the age of 87.

E. H. Mattingley has resigned as general car foreman of the Baltimore & Ohio and Baltimore & Ohio Chicago Terminal and is now in the service of the Chicago-Cleveland Car Roofing Company.

F. E. Sheehan, representative at St. Louis, Mo., of the Texas Company, Houston, Texas, has been appointed assistant district manager of the Western district, with headquarters in the Arcade building, St. Louis.

W. H. Marshall, chairman of the board of Consolidated Machine Tool Corporation of America, New York, has been elected president, to fill the vacancy caused by the sudden death of C. K. Lassiter on March 3.

J. E. Johnson, manager of the Pittsburgh, Pa., branch of the Garlock Packing Company, Palmyra, N. Y., has been appointed

general sales manager, with headquarters at Palmyra, succeeding John N. Todd, resigned.

W. A. Day has been appointed manager of sales for the territory north of the Ohio river for the Casey-Hedges Company, Chattanooga, Tenn., manufacturers of boilers, with headquarters in the Marquette building, Chicago.

C. B. Flint, formerly sales manager of the railroad department of the Paige & Jones Chemical Company, New York City, has been made first vice-president in charge of the railroad department, with headquarters in New York City.

Carl H. Peterson has been appointed Eastern sales representative of the Standard Stoker Company, with headquarters at 5054 Grand Central Terminal, New York City. He served from 1892 to 1904 as engineering representative at Chicago for the Safety Car Heating & Lighting Company, and with the Pressed Steel Car Company in the engineering and sales departments from 1904 to 1905, at Chicago. From 1905 to 1919, he was with the Baldwin Locomotive Works and Standard Steel Works Company as assistant manager at Chicago, Southwestern representative at St. Louis and Western representative at Chicago. Since 1919 Mr. Peterson has been engaged in consulting work, specializing along sales engineering and production lines.

C. H. Peterson

Fred W. Stubbs has been appointed mechanical engineer of the Standard Stoker Company, with headquarters at Erie, Pa. He was born in Western Pennsylvania and received his technical training at Case School of Applied Science, Cleveland, O. He served as machinist apprentice from 1887 to 1888 on the Union Pacific and then to September, 1891, at the Brooks Locomotive Company, Dunkirk, N. Y. From June, 1896, to November, 1898, he was with various contracting companies in Cleveland as a draftsman and subsequently served as draftsman with the Brooks and the American Locomotive Companies and the New York Air Brake Company. In September, 1904, he went with the Industrial Works, Bay City, Mich., and in May, 1905, went to the Wellman-Seaver-Morgan Company. He later served with the Bartlett & Snow Company and the American Machine Company. In May, 1906, he was appointed leading locomotive man in the mechanical engineer's office of the Lake Shore & Michigan Southern. From April, 1911, to January, 1923, he was mechanical engineer of the Chicago Great Western at Oelwein, Iowa. He also served as a member of the Iowa Board of Examining Engineers, resigning as chairman of the board to go to the Standard Stoker Company.

F. W. Stubbs

Thomas C. deRosset, manager southern sales of the T. H. Symington Company, with headquarters at Baltimore, Md., died suddenly in that city on April 7. Mr. deRosset was born in Wilmington, N. C., on September 7, 1875. He entered the sales department of the T. H. Symington Company, Baltimore, in 1905, and was appointed manager Southern sales in 1910, his services in this capacity extending over a period of 13 years. Mr. deRosset was well known throughout the railway and supply field.

The Charter Gas Engine Company, Sterling, Ill., has bought the entire Mietz oil engine (also known as Mietz and Weiss) business, heretofore carried on in New York City by the August Mietz Corporation and the Reliance Oil Engine Corporation.

The Inland Steel Company is preparing plans for the enlargement of its No. 2 plant at Indiana Harbor, Ind., which will include four additional open hearth furnaces, which will increase the steel making capacity approximately 25 per cent.

Hunter Michaels, advertising manager of the Union Metal Products Company, with headquarters at Chicago, has been appointed sales agent of the Railway Steel Spring Company, with the same headquarters, succeeding D. B. Fulton, resigned.

G. W. Wagner, general purchasing agent of the Detroit United Railway, has entered the employ of the I. M. Jacobson & Sons Company, and has been placed in charge of the steam and electric railway sales division with headquarters at Detroit, Mich.

W. O. Ashe, assistant engineer in the equipment engineering department of the New York Central with headquarters at New York, has been appointed mechanical engineer of the Commonwealth Steel Company, with headquarters at St. Louis, Mo.

A. H. Talbot has opened an office at 237 Railway Exchange building, Chicago, under the firm name A. H. Talbot-Railway Equipment to deal in railway locomotives, cars and rails. A. M. Talbot, formerly secretary and treasurer of J. T. Gardner, Inc., Chicago, will be in charge.

O. L. Chapman and W. H. Chapman, formerly with the Davis Boring Tool Company, St. Louis, have been appointed secretary and treasurer, respectively, of the Firmhill Machine Supply Company, Detroit, Mich., succeeding C. C. Firmin, who is no longer identified with the company.

At a recent meeting of the stockholders of the American Boiler Tube Thimble Company, Providence, R. I., the following officers were elected: President, William J. Greene; vice-president, Thomas P. Himes; treasurer and general manager, J. D. Cameron; secretary, M. E. Murray.

The United States Electrical Tool Company, Cincinnati, Ohio, has recently opened a new district office at 430 North High street, Columbus, Ohio, with E. M. Beeler as manager; also a new district office at 412 First street, National-Soo Line building, Minneapolis, Minn., with Thomas H. Caley as manager.

The Metal & Thermit Corporation, New York City, has appointed C. F. Lederer as general supervisor of rail welding in charge of all technical work in the field. This company will move its Pittsburgh branch into a new shop completely equipped with new facilities and located at 1514 Fayette street, N. S.

The Gibb Instrument Company, Bay City, Mich., manufacturers of electric welding equipment, has opened a sales office in Cleveland, Ohio, at 2104 East Superior avenue in charge of W. O. Little, also one in the General Motors building, Detroit, Mich., in charge of F. M. Luchs, formerly chief engineer for the company.

Howard E. Boardman, for the past seven years engineering assistant to the general valuation counsel of the New York Central lines at New York, resigned on March 31 to become president and treasurer of Foster, Merriam & Co., Meriden, Conn. The latter firm is an old established manufacturer of cabinet hardware.

The William E. Kelly Company, dealer in railway specialties, MacCormick building, Chicago, Ill., has been appointed railroad representative of the Van Dorn Iron Works Co., Cleveland, Ohio, for the western, southwestern and northwestern territory, handling that company's complete line of heavy forgings, steel office furniture and equipment.

The Combustion Engineering Corporation, Ltd., New York, and the Uehling Instrument Company, Paterson, N. J., have recently entered into an agreement whereby Uehling interests in the Dominion of Canada and Newfoundland will be handled exclusively by the Combustion Engineering Corporation, Ltd., with offices in Toronto, Montreal, Winnipeg and Vancouver.

The Equipment Specialties Company, Chicago, has been organized to manufacture and sell railway car specialties. The company will be located at 166 West Jackson boulevard, Chicago. The officers of the company are: L. L. Cohen, president; George A. Hull, vice-president; W. R. Gillies, secretary; and C. Mosier, treasurer. The company will be under the active management of Mr. Hull.

Charles D. Jenks has resigned as president and a director of the Damascus Brake Beam Company, Cleveland, Ohio, and has been appointed a vice-president of the Chicago-Cleveland Car Roofing Company, with headquarters at Chicago. Mr. Jenks was born in Philadelphia, Pa. He entered railroad service with the Pennsylvania Railroad, with which road he was employed in the freight and operating departments at Philadelphia for nine years. He then resigned to enter the employ of the Atlantic Refining Company, Philadelphia, in the engineering and construction department. In 1900, he became assistant to the vice-president of the Pressed Steel Car Company, with headquarters at Pittsburgh, Pa., and later was promoted to sales agent, with headquarters at Chicago, which position he held until 1910, when he was appointed western sales manager of the Standard Coupler Company, with headquarters at Chicago. From 1912 to January 31, 1918, he was general manager of Edwin S. Woods & Company and from the latter date until February 28, 1923, he was president and a director of the Damascus Brake Beam Company, Cleveland, Ohio. In June, 1922, he was elected vice-president of the Railway Supply Manufacturers' Association.

Charles D. Jenks

Robert F. Eissler for the past two years assistant to the vice-president of the Chicago Pneumatic Tool Company, New York, has been appointed district manager at Pittsburgh. Nelson B. Gatch, district manager at New York, has been appointed assistant to vice-president, with headquarters at New York, succeeding Mr. Eissler, and William C. Straub has been appointed district manager at New York, to succeed Mr. Gatch.

The Service Motors, Incorporated, a new Delaware corporation, has taken over the business of the Service Motor Truck Company, Wabash, Ind., and will continue to build service motor trucks and service railroad motor coaches. Paul Moore, Wabash, Ind., is president and general manager of the new company; C. W. Folds, Chicago, vice-president; Charles Guernsey, Wabash, vice-president; G. L. Gillam, Wabash, vice-president, and E. L. Mock, Wabash, secretary-treasurer.

E. M. Speakman, formerly machine shop foreman of the Virginian Railway, and B. O. Yearwood, formerly chief inspector of the U. S. Railroad Administration at the Richmond Works of the American Locomotive Company, are now in the service of the Franklin Railway Supply Company, Inc., New York, as inspectors at builders' plants, and A. M. Meston has been appointed service engineer on the Pacific Coast. Mr. Meston resigned recently as district road foreman of engines of the Southern Pacific.

Edward C. Waldvogel, general manager of the Yale & Towne Manufacturing Company, Stamford, Conn., has been elected a vice-president. His title in the future will be vice-president in charge of sales superseding the former title of general manager. He entered the service of the Yale & Towne Manufacturing Company as a traveling salesman in 1905. In 1910 he was transferred to New York as assistant to the general manager. In 1912 he was appointed assistant general manager and since 1916 served as general manager.

The Curtain Supply Company has just moved into its new quarters at Elkhart, Ind. The location comprises about four acres of land on which a modern, one-story, concrete and steel, fire-proof building occupying an area of approximately 79,000 square feet has been built. The general offices of the company are located at Elkhart, where T. W. Holt, second vice-president and general manager, has his headquarters and the company has an office in Chicago at 355-361 West Ontario street, where Holmes Forsyth, president, and W. W. Willits, first vice-president and treasurer, are located.

Harold Rosendahl of the sales department of the Mahr Manufacturing Company, Minneapolis, Minn., has been promoted to district manager with headquarters at Pittsburgh, Pa. J. O. Connelly has been appointed eastern representative with headquarters at New York succeeding W. H. White resigned and will be assisted by R. G. White. E. F. Piea has been placed in charge of the Philadelphia office. Jacob Ebert has been placed in charge of the Baltimore office. J. L. Scanlon has been placed in charge of the Buffalo office. A. D. Fishel has been placed in charge of the Cleveland office.

Vinton E. Sisson, mechanical engineer and patent engineer of the Union Metal Products Company, with headquarters at Chicago, has been promoted to patent counsel in which position he will be in charge of the patent department. Mr. Sisson has been associated with the Union Metal Products Company for the past 12 years, prior to which time he was employed by the American Car & Foundry Company in the engineering department. He has also been employed in the engineering department of the Pressed Steel Car Company. Mr. Sisson has also patented several designs for steel ends, centering devices and buffer springs.

Ground has been broken for the construction of a new plant unit for the DeVilbiss Manufacturing Company, Toledo, Ohio, makers of the DeVilbiss spray-painting system, which will call for an expenditure of $1,000,000, including equipment. This new unit of fireproof brick and concrete construction with four stories will be 580 ft. long by 80 ft. deep. The structure is the first of two similar buildings to be constructed on the company's 55-acre factory plot to afford more adequate plant room and improved production facilities for the rapid and substantial expansion of the business. The DeVilbis Company expects to occupy the new building within six months.

The American Tool & Manufacturing Works, Chicago, has been organized to design and manufacture special machinery, dies, jigs and fixtures and to manufacture screw machine and punch press products. A. B. Cochrane, formerly district sales manager of the Steel & Tube Company of America, with headquarters at Chicago, is president and Robert Hofstetter, formerly an engineer with the Illinois Tool Works, Chicago, and the Nash Motors Company of Kenosha, Wis., is manager. Mr. Cochrane was employed by the American Sheet & Tin Plate Company in various positions previous to 1909, when he resigned to become assistant traffic manager of the Mark Manufacturing Company, with headquarters at Chicago, and was later promoted to traffic manager. On September 6, 1917, he enlisted in the United States Navy and was made chief petty officer in charge of transportation in the ninth, tenth and eleventh Naval districts. He was discharged from the navy on March 15, 1919, and returned to the Steel & Tube Company of America, formerly the Mark Manufacturing Company, as district sales manager, with headquarters at Chicago. In August, 1922 he resigned and on March 1, 1923, organized the American Tool & Manufacturing Works.

A. B. Cochrane

Major Abram J. Gifford, formerly in charge of the transportation department of the General Electric Company, Schenectady, N. Y., for many years, died on March 20 at his home in Schenectady. He was born at Hudson, N. Y., in 1849. He became connected with the Northeast Thomson-Houston Company

at St. Paul in 1891 and in 1894 he was transferred to the transportation department of the General Electric Company at Chicago. In 1899 he was placed in charge of the transportation interests of the company and moved to Schenectady. On March 1, 1920, he gave up his active duties, which were taken over by M. C. Fitzgerald, but he continued in an advisory capacity.

Winslow Blanchard, president of the Blanchard Machine Company, Cambridge, Mass., died at his home in Waban, Mass., on April 7. Mr. Blanchard was born in Dorchester, Mass., September 24, 1865, and was a graduate of the Institute of Technology. In his early professional life he served on the engineering staff of the Boston Heating Company but for more than 20 years he had been associated with the company of which he was the head. He had held all the chief executive offices of the Boston branch of the National Metal Trades Association and at the time of his death was one of three honorary members. He was treasurer of the Associated Industries of Massachusetts and first vice-president of the National Machine Tool Builders' Association.

W. W. Darrow, vice-president of the Camel Company, with headquarters at Chicago, has been promoted to president, succeeding Mr. Elliott. Mr. Darrow was born on August 29, 1882, at Ft. Atkinson, Wis., and in July, 1901, he entered the employ of the Camel Company as a bookkeeper. In 1903 he was promoted to secretary, which position he held until January 1, 1918. On the latter date he was promoted to vice-president. Hugh E. Creer, assistant to the vice-president in charge of sales, with headquarters at Chicago, has been promoted to vice-president. Mr. Creer was born on August 10, 1874, at Hardin, Mo., and entered railroad service in 1898 in the car department of the Missouri Pacific. In 1905, he entered the employ of the Pere Marquette, where he remained until 1910, when he returned to the Missouri Pacific. In 1911, he entered the employ of McCord & Co. as a salesman. In 1916 he entered the employ of the Camel Company in the same capacity, and in May, 1917, he was promoted to assistant to vice-president in charge of sales. A. B. Wegener, secretary, with headquarters at Chicago, has been appointed secretary and treasurer. Mr. Wegener was born at St. Paul, Minn., and entered the employ of the American Bridge Company, with headquarters at Chicago, in 1900 and in 1908 was promoted to credit manager. He entered the employ of the Camel Company as a salesman in 1912, with headquarters at Chicago, and on January 1, 1916, was promoted to general manager of sales. He was promoted to secretary in 1917, which position he has held until his recent appointment.

W. W. Darrow

V. Villette, mechanical expert, Pacific district of the Westinghouse Air Brake Company, has been promoted to representative, Westinghouse Air Brake Company and Westinghouse Traction Brake Company of the same district, with office at San Francisco, Cal. A. C. Layton, a locomotive engineman on the Los Angeles division of the Southern Pacific, succeeds Mr. Villette as mechanical expert. Raymond Boiselle, mechanical expert, Westinghouse Traction Brake Company, St. Louis, Mo., has been transferred to Wilmerding, Pa., as representative, Westinghouse Air Brake Company and Westinghouse Traction Brake Company, Pittsburgh district. F. C. Young, industrial representative, Pittsburgh district, has been promoted to representative, Westinghouse Air Brake Company and Westinghouse Traction Brake Company for the same district. S. B. Schrontz, chief clerk, Pittsburgh district office, has been appointed industrial representative, Pittsburgh district, assisting Mr. Young, and E. H. Weaver, industrial representative, Pittsburgh district, has been transferred to the Chicago office as inspector for the Westinghouse Air Brake Company.

TRADE PUBLICATIONS

OVERHEAD CARRIER SYSTEM.—The Chisholm-Moore Manufacturing Company, Cleveland, Ohio, has issued a new circular featuring its Atlas Carryall overhead carrying system; also a 16-page booklet describing in detail the steps necessary in making Carryall installations.

GRINDING MACHINES.—Various types of hole grinding machines, link grinding machines, plane surface grinding machines, crank-pin grinding machines and abrasive wheels are illustrated and described in a 15-page catalogue recently issued by Beyer, Peacock & Co., Ltd., Gorton, Manchester, England.

GASOLINE RAIL CARS.—The International Motor Company, New York, has issued a catalog describing Models AC and AB rail motor cars now in service on a number of railroads. A brief description is given also of the new Model AH which is 55 ft. long and contains a baggage compartment in addition to provision for 51 passengers.

PRODUCTION TOOLS.—Scully-Jones & Co., Chicago, has issued Catalogue 33 outlining the advantages and adaptability of each of its Wear-Ever production tools, which include chucks, milling cutters, special tool holders, collets, etc. Practical suggestions for improvements in machine shop practice, reference data, charts and tables have also been included in this 40-page booklet.

PIPE THREADING MACHINERY.—The Landis Machine Company, Waynesboro, Pa., has recently issued catalogue No. 24 in which its line of stationary pipe die heads, pipe threading and cutting machines, rotary pipe and nipple threading die heads, pipe and nipple threading machines, automatic die heads and chaser grinders are illustrated and described in detail. The catalogue is carefully prepared and printed, containing 75 six-inch by nine-inch pages.

INTERNAL COMBUSTION ENGINES.—The Stover Manufacturing & Engine Company, Freeport, Ill., has issued a 24-page booklet describing its line of internal combustion engines. The engines listed range from 1 to 30-hp. capacity and include both the make-and-break type for gasoline and kerosene fuels and the semi-Diesel type for fuel oil. Halftone illustrations are given of the various models and specifications of each type are included with the descriptive matter contained.

GAS ENGINES.—The Noble Company, Lansing, Mich., has issued a folder illustrating and describing its line of internal combustion engines in various combinations for various kinds of work. Illustrations show various kinds of pumping combinations, both portable and stationary, in which the engine is shown adapted to operating centrifugal and plunger pumps as well as the diaphragm pumps. Illustrated descriptions of the various kinds of hoists are included and some attention is given to the use of air compressor combinations.

UNARCO PRODUCTS.—The United Asbestos & Rubber Company, Chicago, has recently issued catalogue No. G-22, which is a 111-page, cloth bound book containing a complete list of its line of packings, belting; roofings; car insulation; electrical insulation; mechanical rubber goods, including air brake hose, signal hose and injector suction hose, and asbestos and magnesia materials. The various classes of goods, which are well illustrated and described, are listed in five groups under separate section headings and the catalogue contains a complete alphabetical index.

MACHINE TOOLS AND CRANES.—In a large, well illustrated booklet entitled, Recent Developments in Machine Tools and Cranes for Railroads, Manning, Maxwell & Moore, Inc., New York, describes improvements in some of its more important products used by the railroads. Comparatively dull years since the armistice have been used in changing designs and patterns so that with the improved equipment shopmen can obtain maximum production with minimum physical effort. First position in the booklet is given to the Putnam wheel lathes which are followed by heavy duty car wheel borers, axle lathes, boring mills, slotters and other standard tools handled by the company. Several pages are devoted to shop cranes, steam hammers, wheel presses, punches and shears, flue welders, staybolt threading, radius grinders and other shop machines.

EQUIPMENT AND SHOPS

Locomotive Orders

The Kansas City Southern has ordered 10 2-8-8-2 Mallet type locomotives from the American Locomotive Co.

The Wabash has ordered 30 2-8-2 type locomotives and 20 switching type locomotives from the American Locomotive Company.

The Florida East Coast has ordered 15 4-8-2 type and five 0-6-0 switching locomotives from the American Locomotive Company.

The Carolina, Clinchfield & Ohio has ordered 10 2-8-2 type locomotives and 12 Mallet (2-8-8-2) type locomotives from the American Locomotive Company.

The Lehigh Valley has ordered 40 2-8-2 type locomotives from the American Locomotive Company. This road will place orders shortly for 10 4-6-2 type locomotives for passenger service.

The Pacific Electric has placed an order with the Westinghouse Electric & Manufacturing Co., for two 43-ton electric locomotives and will build in its own shops eight electric locomotives weighing 60 tons.

The Canadian Pacific has placed an order for 29 2-8-2 type (P-2) locomotives, to have a tractive effort of 56,100 lb., with the Montreal Locomotive Works. An order has also been placed for 6 steel snow plows to be built in the railroad company's shops at Angus.

Freight Car Orders

The Fruit Growers Express will build 2,000 refrigerator cars in its own shops.

The Denver & Rio Grande Western will build 100 narrow gage stock cars in its own shops.

The Atlantic Coast Line has ordered 450 gondola cars from the Virginia Bridge & Iron Company.

The Sun Oil Company, Philadelphia, Pa., has ordered 150 tank cars from the Standard Tank Car Company.

The Bertha Coal Company has ordered 300 hopper cars of 55 tons' capacity from the Pressed Steel Car Company.

The United States Fuel Company has ordered 500 hopper cars of 70 tons' capacity from the General American Car Company.

The Southern Pacific has ordered 350 steel ballast cars for 1923 delivery from the Mount Vernon Car Manufacturing Company.

The Duluth, Missabe & Northern has ordered 100 steel box cars of 50 tons' capacity from the American Car & Foundry Company.

The Roxana Petroleum Corporation, St. Louis, Mo., has ordered 359 tank cars of 10,000 gal. capacity from the Standard Tank Car Company.

The New England Oil Refining Company, Boston, Mass., is having 250 tank cars built in the shops of the General American Tank Car Corporation.

The Johnstown Coal & Coke Company, Johnstown, Pa., has ordered 150 hopper cars of 55 tons' capacity from the American Car & Foundry Company.

The Emmons Coal Mining Company, Philadelphia, Pa., has ordered 500 hopper cars of 70 tons' capacity from the American Car & Foundry Company.

The Virginian Railway has ordered from the Pressed Steel Car Company 1,000 120-ton all-steel gondola coal cars and has also ordered from the Standard Steel Car Company 500 all-steel 70-ton hopper cars.

The Erie has ordered 1,000 box cars from the Pressed Steel Car Company; 1,000 box cars and 1,000 gondola cars from the Standard Steel Car Company, and 1,000 gondola cars from the Youngstown Steel Car Company.

The New York Central has ordered 2,000 refrigerators cars for the Michigan Central from the Merchants Dispatch Transportation Company. In the April *Railway Mechanical Engineer* mention was made that 1,500 of these cars were under construction in the shops of the Merchants Dispatch.

The Boston & Maine has ordered 300 flat cars of 55 tons' capacity from the Magor Car Corporation, 200 refrigerator cars of 35 tons' capacity from the Merchants Dispatch Transportation Company and 100 Hart convertible ballast cars of 50 tons' capacity from the American Car & Foundry Company.

The Chesapeake & Ohio, reported in the April *Railway Mechanical Engineer* as having ordered 1,000 70-ton hopper cars from the American Car & Foundry Company and 1,000 from the Standard Steel Car Company, has increased its order 1,000 cars to each company, making a total of 4,000 cars ordered recently.

Freight Car Repairs

The Baltimore & Ohio will rebuild 1,000 coke cars in its own shops.

The Denver & Rio Grande Western is repairing over 1,000 freight cars in its own shops.

The Chesapeake & Ohio has let a contract for repairing 1,500 freight cars at the shops of the Richmond Car Works.

The Norfolk & Western is reported as having placed an order for repairs to 700 hopper cars with the Ralston Steel Car Company.

The Missouri Pacific has ordered repairs to 1,500 box cars from the Springfield Car & Equipment Company and repairs to 600 coal cars from the Mt. Vernon Car Manufacturing Company.

The Seaboard Air Line is inquiring for 25 caboose cars. This company is having repairs made to 1,000 box cars at the shops of the Richmond Car Works. Five hundred box cars are being repaired at Atlanta and some additional cars are being repaired at shops in Tampa.

The Illinois Central will have 1,000 gondola cars and 600 40-ton box cars repaired by the Ryan Car Company and 800 50-ton box cars, and 600 40-ton box cars repaired by the American Car & Foundry Company. Orders have also been placed for repairs to 300 36-ft., 40-ton box cars with the Midwest Engine Company, for repairs to 100 36-ft. steel box cars with the Pullman Company and for repairs to 150 automobile box cars with the Ryan Car Company.

Passenger Car Orders

The Pullman Company is building 100 sleeping cars in its own shops.

The Arms-Yager Railway Car Company has ordered 50 cars for passenger service from the Pullman Company.

The Illinois Central has ordered 6 horse baggage and 8 baggage cars from the Standard Steel Car Company; and 2 cafe lounge cars, 4 parlor cars, and 5 dining cars from the Pullman Company. This company has also ordered 25 60-ft. 6-in. steel suburban coaches from the Pullman Company.

The Louisville & Nashville has ordered 14 baggage cars and 10 70-ft. combination baggage and mail cars from the Pressed Steel Car Company; and 14 70-ft. baggage cars, five 61-ft. coaches, five 61-ft. middle room smoking coaches, two dining cars, and 10 coaches from the American Car & Foundry Company.

The Southern Pacific has ordered five 60-ft. chair cars, five 60-ft. coaches, fifteen 72-ft. coaches, fifteen 70-ft. baggage cars and one 72-ft. 6-in. combination coach and baggage car from the American Car & Foundry Company; sixty 72-ft. interurban coaches and ten 77-ft. dining cars from the Pullman Company; forty 70-ft. combination baggage and postal cars from the Standard Steel Car Company. All the above cars are to be of steel construction and all are for the Southern Pacific Lines except the one 72-ft. 6-in. combination coach and baggage car, which is for the San Diego & Arizona.

Machinery and Tools

THE PENNSYLVANIA has ordered equipment for three flue shops from Joseph T. Ryerson & Son, Inc.

THE INTERNATIONAL-GREAT NORTHERN has ordered one 120-ton wrecking crane from the Industrial Works.

THE LOUISVILLE & NASHVILLE has ordered one, 20-ton locomotive crane from the Browning Company.

THE NORFOLK & WESTERN has placed orders for a car wheel borer, an axle lathe, a wheel press, a 36-in. planer; also for a number of other tools.

THE MAINE CENTRAL has placed orders for 2, 5-ft. radial drills, 2 bushing presses, a 36-in. planer; also some other tools, including one 200-ton locomotive hoist for use at Portland, Me., from the Whiting Corporation, and a 40-ton, 50-ft. boom locomotive crane from the Industrial Works.

Shops and Terminals

PERE MARQUETTE.—This company has awarded a contract to the Arnold Company, Chicago, for the construction of a roundhouse at Grand Rapids, Mich.

ELGIN, JOLIET & EASTERN.—This company has awarded a contract to the T. S. Leake Construction Company, Chicago, for the construction of a 20-stall roundhouse at Gary, Ind.

EL PASO & SOUTHWESTERN.—This company has awarded a contract to Anderson Brothers, El Paso, Tex., for the construction of a 10-stall addition to the roundhouse at El Paso.

BALTIMORE & OHIO.—This company has awarded a contract to Joseph E. Nelson & Sons, Chicago, for the construction of a water treating plant of 25,000 gal. per hour capacity at Ivorydale, Ohio.

CHESAPEAKE & OHIO.—This company has awarded a contract to Joseph E. Nelson & Sons, Chicago, for the construction of an addition to the store house at Huntington, W. Va., to cost approximately $80,000.

CHICAGO, ROCK ISLAND & PACIFIC.—This company has awarded a contract to the Railroad Water & Coal Handling Company, Chicago, for the construction of oil stations, to cost $15,000 each, at El Dorado, Ark., Haskell, Tinsman and Malvern.

GALVESTON, HARRISBURG & SAN ANTONIO.—This company has awarded a contract to V. E. Ware, El Paso, Tex., for the construction of a locomotive erecting shop at El Paso. The structure will be 258 ft. long by 84 ft. wide with a height of 60 ft. and will cost $200,000, including cranes, pits, tracks and drainage. It will be of structural steel frame, brick walls, steel sash and concrete floors and equipped with one 200-ton and one 15-ton traveling crane.

PENNSYLVANIA.—This company has awarded a contract to the Hughes-Foulkrod Company, Pittsburgh, for the erection of walls, roof, skylight and sash for its new shops at Juniata. The Wilson & English Construction Company have the contract for foundation and flooring and the McClintic-Marshall Company for the structural steel frame. The building will be 340 ft. by 690 ft. and will be equipped with two 250-ton cranes, four 50-ton cranes and 50 pits. The shop will have a capacity for heavy repairs to 100 locomotives a month.

LEHIGH & NEW ENGLAND.—This company has adopted plans for modern and adequate facilities for the handling of locomotives and trains in the Panther creek valley between Hauto, Pa., and Tamaqua, Pa., in which are located the anthracite collieries served by it. The plans provide for a new yard and engine terminal to be located near Tamaqua, Schuylkill county, Pa., at an estimated cost of approximately $465,000, and include besides track work a 10-stall roundhouse, an 85-ft. turntable, a 200-ton capacity coaling station, two ash-pits, an oil-house and equipment, a water tank, a car repair shop and a yard office building. A contract has been awarded to the H. Denburger Contracting Company, Bethlehem, Pa., for the grading, concrete masonry, drainage and track laying (including change of creek channel), excavating and the building of the concrete foundation for turntable, excavating and putting in ash-pit foundations, and building concrete abutments on new location of crossings of Panther creek by the railroad's tracks and a private road, at an estimated cost of $126,000.

PERSONAL MENTION

General

G. H. LANGTON has been appointed mechanical inspector of the Chesapeake & Ohio.

ALFRED E. CALKINS has been appointed superintendent of rolling stock of the New York Central Lines, Buffalo and East, with headquarters at New York.

C. K. WOODS, master mechanic of the Pere Marquette, with headquarters at Saginaw, Mich., has been promoted to assistant superintendent of motive power, with headquarters at Detroit.

M. C. M. HATCH, mechanical engineer of the Missouri-Kansas-Texas with headquarters at Parsons, Kansas, has been promoted to assistant to the executive vice-president with headquarters at St. Louis, Mo.

J. W. SENGER, master car builder on the New York Central, with headquarters at Collinwood, Ohio, has been promoted to superintendent of rolling stock of the Lines West of Buffalo, with headquarters at Cleveland, Ohio.

J. F. WALKER has been promoted to superintendent of the New Orleans division of the Yazoo & Mississippi Valley with headquarters at Vicksburg, Miss. Mr. Walker was born on November 21, 1877, at Paducah, Ky. He entered railway service on January 10, 1898, as a special machinist apprentice in the Paducah shops of the Illinois Central and two years later was promoted to journeyman. He was promoted to roundhouse foreman in January, 1901, and was subsequently promoted to machine shop foreman, in which position he served until September, 1906, when he was promoted to general foreman of the Evansville district, with headquarters at Princeton, Ky. He was transferred to the Paducah shops in May, 1907, and held this position until August, 1909, when he was promoted to master mechanic, with headquarters at East St. Louis, Ill. He was transferred to Paducah in May, 1910, and served in this capacity until the time of his recent promotion to superintendent of the New Orleans division.

J. F. Walker

H. MODAFF, superintendent of shops of the Chicago, Burlington & Quincy, with headquarters at Aurora, Ill., has been promoted to assistant superintendent of motive power, Lines East of the Missouri river, with headquarters at Chicago.

J. C. BRYAN, superintendent of shops of the St. Louis-San Francisco, with headquarters at St. Louis, Mo., has been appointed mechanical assistant to the manager of purchases of the American Short Line Railroad Association, with headquarters at Chicago.

WM. E. BARNES, whose appointement as superintendent of motive power of the Canadian National with headquarters at Moncton, N. B., was announced in the April *Railway Mechanical Engineer*, was born at Shediac, N. B., on July 24, 1879. He entered railway service in 1899 as a machinist's apprentice at Moncton. Three years later he was promoted to draftsman. For a short time in 1906 he served as a machinist and then again as draftsman. In 1907 he became a fitter and two years later was again transferred to the drafting room. In 1910 he was appointed enginehouse inspector; a year later as acting master mechanic. In 1912 he was promoted to master mechanic. In 1917-1918 he served as general master mechanic on the Lines East of Mont Joli. From that time until his appointment as

superintendent of motive power he served as master mechanic at Moncton, N. B., at which point he has been stationed throughout his entire railway service with the single exception above noted.

W. G. Black, whose promotion to superintendent of motive power of the New York, Chicago & St. Louis, with headquarters at Cleveland, Ohio, was reported in the April *Railway Mechanical Engineer*, entered railway service in February, 1903, as a machinist on the New York, Chicago & St. Louis, at Stony Island (Chicago), Ill. He was promoted to foreman of the machine shop in July of the same year and served in this capacity until February, 1904, when he was promoted to roundhouse foreman at Ft. Wayne, Ind. He held this position until January 1, 1909, when he was promoted to master mechanic, with headquarters at Stony Island, Ill., in which position he was serving at the time of his recent promotion to superintendent of motive power, with headquarters at Cleveland, Ohio.

Master Mechanics and Road Foremen

C. A. Kimmel has been appointed terminal master mechanic of the Union Pacific at Pocatello, Idaho.

H. N. Seely, general foreman, locomotive department of the Illinois Central, with headquarters at Waterloo, Iowa, has been promoted to master mechanic, with headquarters at Centralia, Ill., succeeding C. M. Starke, transferred.

R. A. Reid, assistant master mechanic of the Pere Marquette, with headquarters at Saginaw, has been promoted to master mechanic, with the same headquarters, succeeding Mr. Woods. C. F. Willoughby, mechanical inspector, with headquarters at Detroit, has been promoted to assistant master mechanic, with headquarters at Saginaw, succeeding Mr. Reid.

H. G. Kastlin, master mechanic of the La Crosse division of the Chicago, Burlington & Quincy, with headquarters at Grand Crossing, Wis., has been transferred to the Creston division, with headquarters at Creston, Iowa. C. W. Robertson, master mechanic of the Creston division, with headquarters at Creston, Iowa, has been transferred to the La Crosse division, with headquarters at Grand Crossing, Wis., succeeding Mr. Kastlin.

Tracy C. Baldwin, whose appointment as master mechanic of the New York, Chicago & St. Louis at Stoney Island, Ill., was announced in the April issue of the *Railway Mechanical Engineer*, was born at East Springfield, Pa., on June 15, 1875. He entered the employ of the New York, Chicago & St. Louis in June, 1889, as a messenger and toolroom boy at Conneaut, Ohio. From November, 1892, to April, 1896, he was machinist apprentice; from April, 1896, to January, 1904, machinist and toolmaker, and from January, 1904, to May, 1905, machine shop foreman. From May, 1905, to May, 1910, he was roundhouse foreman at Buffalo, N. Y. In May, 1910, he returned to Conneaut as general machine shop foreman, and from April, 1915, until his promotion as noted above, he was superintendent of shops.

Tracy C. Baldwin

R. H. Flinn, master mechanic of the St. Louis division of the Pennsylvania with headquarters at Terre Haute, Ind., has been transferred to the Indianapolis, Louisville and South Bend divisions with headquarters at Indianapolis, Ind., succeeding T. F. Butler, retired. H. R. Voelker, assistant master mechanic of the Indianapolis division with headquarters at Indianapolis, has been promoted to master mechanic of the St. Louis division with headquarters at Terre Haute, Ind., succeeding Mr. Flinn. T. F. Haynes, assistant engineer of motive power, with headquarters at Columbus, Ohio, has been promoted to assistant master mechanic of the Indianapolis, Louisville and South Bend divisions with headquarters at Indianapolis, succeeding Mr. Voelker.

Car Department

Paul Maddox has been appointed superintendent of the car department of the Chesapeake & Ohio with headquarters at Richmond, Va.

E. H. Meckstroth, car foreman of the Baltimore & Ohio at Cleveland, Ohio, has been appointed general foreman with headquarters at Chicago, succeeding Mr. Mattingley, resigned.

Geo. E. McCoy, whose appointment as superintendent of car equipment of the Atlantic region of the Canadian National with headquarters at Moncton, N. B., was announced in the April *Railway Mechanical Engineer*, was born on January 8, 1886, at Moncton, N. B., and was educated in the public schools of that city. He entered railway service in 1900 as a machinist and draftsman apprentice with the Intercolonial Railway. In 1905 he was promoted to draftsman and served in that capacity until 1914 when he was appointed assistant chief draftsman for the Canadian Government Railways with which the Intercolonial had been merged. Two years later he was promoted to assistant master car builder. On December 20, 1918, he was advanced to master car builder of the Canadian National, Eastern lines, and held that position until the time of his recent appointment as superintendent of car equipment of the Atlantic region.

G. E. McCoy

James Reed has been appointed district master car builder of the New York Central with jurisdiction over the third district and headquarters at Collinwood, Ohio. A. Herbster succeeds Mr. Reed as district general foreman at Collinwood; C. J. Griswold succeeds Mr. Herbster as general foreman at Englewood, Ill.; and R. C. Salyor succeeds Mr. Griswold as general foreman at Elkhart, Ind.

Shop and Enginehouse

George Stroner has been appointed tool supervisor of the Chesapeake & Ohio.

S. M. Carroll has been appointed general master boilermaker of the Chesapeake & Ohio with jurisdiction over the entire system.

O. D. Brizzell and F. B. Harman have been appointed assistant superintendents of shops of the Atchison, Topeka & Santa Fe with headquarters at San Bernardino, Cal.

J. A. Carney, supervisor of fuel economy of the Chicago, Burlington & Quincy, with headquarters at Chicago, has been promoted to superintendent of shops, with headquarters at Aurora, Ill., succeeding Mr. Modaff.

Purchasing and Stores

C. S. Finlayson has been appointed assistant purchasing agent of the Chicago, Milwaukee & St. Paul, with headquarters at Seattle, Wash.

The following appointments in the stores department of the Canadian National have been announced: A. E. Cox, general storekeeper, and D. Robertson, assistant general storekeeper, Western region, Winnipeg; E. J. McVeigh, general storekeeper, and E. D. Toye, assistant general storekeeper, Central region, Toronto; W. E. Logan, general storekeeper, Atlantic region, Moncton, N. B.